AMERICAN SOCIETY OF CIVIL ENGINEERS.

INSTITUTED 1852.

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ADDRESS AT THE ANNUAL CONVENTION AT CAPE MAY, N. J., JUNE 27TH, 1899.

By DESMOND FITZGERALD, President, Am. Soc. C. E.

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The Annual Convention was also planned for the reading and discussion of professional papers, for the improvement of the members and for the encouragement of social intercourse. It does not appear under which of these heads the Address of the President may be included, but whatever its effects upon others or upon the profession, there is little doubt of its effect upon the occupant of the office. It seems highly probable that one filling this exalted station might not only survive all the trials that beset the way, but might even go so far

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as to enjoy the distinction, were it not for this consumer of midnight oil—the Annual Address. For the present incumbent, the choice of a subject became unusually difficult from the fact that his immediate predecessors in office had so ably covered the field. In 1895, in Boston, the meaning and position of the profession and the Society, and the new epoch of the manufacture of power, were discussed by Mr. George S. Morison with a power of analysis which is rarely equalled; in 1896, at San Francisco, Mr. Thomas C. Clarke entered the lists with his exhaustive relations between science and engineering; in 1897, at Quebec, Mr. Benjamin M. Harrod delivered one of the ablest of our long series of addresses, on the relation of civil engineering to the progress of the present time and country, of its opportunities and limitations, and the responsibilities and duties of our Society; and last year, at Detroit, Mr. Alphonse Fteley drew from his rich experience for a review of the progress of engineering. After such intellectual feasts it may not be wondered at if one in this position asks himself : "Are there any crumbs left for me to distribute ?"

Those who have had occasion to study the early condition of engineering in this country and the lives of the fathers of the profession, must have been struck with the paucity of the literature of the subject. As we are apt, in the feverish hurry that surrounds the engrossing pursuits of the present day, to overlook the debt we owe to the founders of civil engineering in the United States, and as the close of the century is an appropriate time for historical review, I have concluded to call your attention to a few of the earliest public works constructed in this country, and particularly to the men who designed and built them.

The history of engineering in America is naturally divided into four periods:

First.—That from 1785 to 1800, embraced in the earliest public works of the country of the nature usually undertaken by the civil engineer.

Second.—That from 1810 to 1830, beginning with the revival of works of internal improvement after a long period of inaction, and extending to the invention of the railroad.

Third.—That from 1830 to 1848, beginning with railroads and extending to the formation of the engineering societies.

Fourth.—That from 1848 to the present time.

Only a rapid survey of the first three of these periods will be attempted.

Before the Revolutionary War of 1776, the spirit of internal improvement had already begun to make itself manifest throughout the Colonies in various directions. Nowhere had this spirit taken more definite form than on the banks of the Potomac.

To John Bellendine, of Fairfax County, Virginia, a person described as possessing skill and judgment in water-works, is probably due the credit of first putting in definite form a scheme for connecting the Potomac River with the Monongahela, and the James with the Kanawha. Bellendine came as near being a civil engineer as any one else in the country at that time. He published, in 1773, his plans for constructing canals and locks for the improvement of the navigation of these rivers. Washington, who was almost an engineer, had already planned projects for connecting the Atlantic Coast with the almost unknown wilds beyond the Alleghenies, but war stopped the hand of progress in public works, and it was not until peace had been declared that the country once more turned to works of internal improvement. Here Washington again took a leading part, and by his exertions was largely instrumental in procuring from the legislatures of Virginia and Maryland a charter incorporating the Potomac Company, formed for the purpose of opening the waters of Chesapeake Bay to navigation from the interior rivers of the States, and ultimately to connect with the Ohio River. This was the earliest charter for any work of considerable magnitude worthy of being classified under engineering. Washington was elected the first president of the company in 1785, and, after subscriptions of stock, the work of improvement began. For some time this was confined to the removal of rocks from the bed of the Potomac River as far as the Great Falls, but the real difficulties of surmounting the 76 ft. of rise in these falls called for the services of an engineer.

In a letter to Edmund Randolph, dated September 16th, 1785, Washington wrote:

"And as the Great Falls are tremendous and the navigation thereof, in whatever manner it is attempted, will require much skill and practical knowledge in the execution; we propose, before this is undertaken, to invite a proper person from Europe, who has been employed in works of this kind, as a superintendent of it."

It is probable that some foreign engineers advised and perhaps designed the locks around the Great Falls.

Work on the Potomac Canal languished toward the last of the century, and, in common with all the other great undertakings of the day, slept until awakened many years later, when the Chesapeake and Ohio River Canal, which absorbed all the works of the old Potomac Company, was formed in 1823.

On January 5th, 1786, an Act for cleaning and improving James River was obtained. Under this Act, the old James River Company constructed a canal around the falls on James River, extending from Richmond to Westham, a distance of about seven miles, and improved the bed of the river by sluices as far as Buchanan.

The Dismal Swamp Canal, extending from a point on the Elizabeth River, near Norfolk, to Albemarle Sound in North Carolina, and passing through the Great Dismal Swamp, in the States of Virginia and North Carolina, was chartered in 1787, and a large amount of work was done before the close of the century; but progress was so slow that the actual connection of the waters of Chesapeake Bay with Albemarle Sound was not made until after the War of 1812.

The operations of the James River Company and the Dismal Swamp Canal, undertaken at about the same time as the Potomac Canal, are so similar in many of their features that they need not be described. The larger part of these enterprises was in the nature of river improvement, combined with lockage at the rapids or falls.

In 1784, South Carolina started a project for the construction of the Santee Canal, the first true canal in the country, of which the name is now almost entirely forgotten. This canal was 22 miles in length, and was built for the purpose of connecting the Santee River with the tidal headwaters of Cooper River, which empties into Charleston Harbor.

The charter for the Santee Canal was obtained March 22d, 1786. Work was begun in 1793, and the canal was finished in 1800. As this was the first work of internal improvement constructed in this country, antedating the famous Middlesex Canal by about three years, it possesses an unusual interest in a consideration of the history of engineering in this country. The Chief Engineer and Director was Colonel Christian Senf, a Swedish engineer, who was at that time Chief Engineer of the State of South Carolina. The total rise and fall

of the canal was 103 ft., overcome by eight single and two double or coupled lift-locks, varying from 5 to 10 ft. lift, and built of stone or brick masonry with wooden gates. The boats were 54 ft. long, 9 ft. beam and 2½ ft. draft. The average dimensions of the canal were 35 ft. wide at top, 20 ft. at bottom, and 4 ft. depth of water. The canal was furnished with 25 flood gates, several overfalls, abutments and walls for bridges, and for 13 miles of its course the digging was 15 ft. deep. The work was constructed by negro laborers, two-thirds of them being men and one-third women, and they were paid £15 to £16 per year.

The reports of the engineer are exceedingly interesting. The following is an extract from one of them:

"You and the Board of Directors will be pleased to remember that from the beginning of the work I have never been able to meet with a tradesman or any other person to assist me who had ever been employed upon similar work. Of course, being obliged to lay out every kind of work myself, and to direct its execution, I have not been able to give you from time to time my progress, as is usual."

There is something heroic in the simple descriptions of this engineer who alone undertook to carry his work to completion in the face of fevers, lack of facilities, and every conceivable obstacle. There is nowhere a reference to its being the first work of its kind in the country, no bombast, no flourish of trumpets, only the straightforward reports of the honest engineer striving to bring order out of chaos. The summit level of the canal was 5 miles in length and was to have been fed by reservoirs and swamps, which, however, afterward proved insufficient, and this was one of the principal causes of the failure of the canal.

In 1880, Colonel Q. A. Gillmore was requested to report upon the re-opening of the canal, under authority of a provision in the Land and Harbor Bill. The report was not favorable, but the engineers found the canal almost intact, although covered with a growth of timber and brush. The locks were generally in place, with the exception of the gates, which had gone to decay. On the advent of railroads, the canal was abandoned. The original cost of the canal was $650 667.14, and the ultimate cost $1 100 000.00. The company owned 110 slaves and 6 000 acres of land.

A project which was proposed and discussed long before the Revolutionary War, in fact by Penn, in 1690, was that of uniting

the Schuylkill and Susquehanna rivers by a canal. The first explorations were made by a Committee of the American Philosophical Society in 1770. The same route was surveyed again, a little later, by the astronomer, David Rittenhouse. In 1789 a few public spirited citizens formed an association and proposed various plans to the Legislature, and in the following year commissioners were appointed to explore several routes. This action resulted in the formation of two companies.

The first was the Schuylkill and Susquehanna Navigation Company, incorporated in 1791, to open a communication between the Schuylkill and Susquehanna rivers from Reading on the Schuylkill to Middletown on the Susquehanna.

The second was the Delaware and Schuylkill Navigation Company, incorporated in 1792, to open a canal from Philadelphia along the east branch of the Schuylkill, 16 miles, to Norristown.

As soon as the companies were organized, committees were appointed to superintend the commencement of the respective works. Unfortunately there was no engineer at that time in Pennsylvania competent to aid the committees; they, therefore, sent to England and engaged Mr. William Weston, an engineer of reputation, to come out and manage both works. In the meantime, the committees did not think it proper to remain idle. They commenced the respective undertakings, and had each well under way when Mr. Weston arrived, in January, 1793.

Early in the following year Mr. Weston made a report on the Schuylkill and Susquehanna navigation, to the effect that the unerring test of experience had proven the inefficiency of undertaking to open water communication by the beds of the creeks, and recommended the construction of a canal 70 miles in length from the Schuylkill to the Susquehanna. The expense he estimated at $821 330.60, in addition to the $400 000 already subscribed.

The company soon became convinced that Mr. Weston was right. Anticipating legislative aid, they worked under Weston's guidance through 1794. In December, 1794, five locks of 6 ft. fall and two road bridges had been completed, and progress had been made on the sixth lock. In this state work was suspended, with $250 000 spent.

In December, 1794, Mr. Weston made a report in regard to the Delaware and Schuylkill project, in which he said: "That one-third

of the work, about 5 miles, was finished, and that contracts were formed and forming for a vigorous prosecution of the remainder," and "that the whole canal of 16 miles could be completed for the sum authorized, $400 000," and, "if the stockholders would punctually pay the sums subscribed by them, a toll for a part of the canal might be drawn in 1796, and the whole completed in 1797 or 1798." In spite of every effort, however, the work languished, and in 1796, when nearly 6 miles of the canal were navigable, the work entirely ceased. The sum of $221 710.06 had been spent on this undertaking.

In 1811 these two companies were galvanized into life under the name of "The Union Canal," but no active operations were begun until 1821, when this historic work was begun and pushed to completion, in 1827, sixty-five years after the first survey, at a cost of $1 600 000.

The Schuylkill navigation was among the earliest works of this period. It was chartered in 1815, and work was commenced in 1816. The entire length of works controlled by the company, including slack-water navigation, was 108 miles. There were 31 dams and 120 locks in this distance, and the total lockage was 620 ft. Navigation was opened in 1825 for boats carrying 18 tons. The engineer was Thomas Oakes, and some of the works built by him are still in use. Oakes must have been an engineer of ability, and he probably came from England.

George Duncan, a Scotch engineer, who succeeded him, built the old tunnel below Pottsville and also the Tumbling Run reservoir system of the Schuylkill navigation, consisting of earth dams, one 48 ft. and the other 60 ft. in height. Duncan also designed and built the dams in the river above Reading, and the Duncan Canal, all now in use and described as admirable works.

While enthusiasm for the constructien of work of inland navigation was aroused further to the South, the great State of New York was not idle. Many years before the close of the eighteenth century public attention had been directed toward the great valleys of the Mohawk and Hudson as furnishing a means of water communication between the City of New York and the Great Lakes. The first steps were not taken, however, until March, 1791, when an Act was obtained to open communication between Wood Creek and the Mohawk River, and also providing for a connection between Lake Champlain and the

Hudson. The latter was known as the Northern Canal and the former as the Western Canal. Under this Act, Mr. Abraham Hardenbergh, a skilful and experienced surveyor, assisted by Mr. Benjamin Wright, made the survey in September and October, 1791. Mr. Wright was destined later to a career of fame as one of the first native civil engineers in America.

In March, 1792, an important Act was passed by the Legislature of New York providing for "opening a lock navigation from the navigable part of Hudson River, to be extended to the Seneca and Ontario Lakes." This legislation gave practical form to the idea of connecting the Hudson with the Great Lakes.

The Western Inland Lock Navigation Company immediately began active work on the improvement of the Oneida Lake, Mohawk and Seneca Rivers. These waters were opened from Schenectady to the Seneca Falls in 1796 for navigation by boats of 15 tons burden. The first locks were built of wood, as were those on the Potomac, and their decay and failure proved a serious blow to the stockholders.

William Weston was employed as engineer, and he rebuilt the locks with masonry, but at such a cost as to exhaust the resources of the company. It is stated that the wooden locks at the Little Falls, German Flats and Rome went to decay in about six years, and that they were rebuilt with brick, which again failed owing to the quality of the mortar, which was probably of lime.

Following closely on the construction of the southern canals came the great undertaking of that day in New England—the Middlesex Canal, which had the honor of being the second real canal constructed in the United States.

The charter was obtained in June, 1793, under the title of "Proprietors of the Middlesex Canal." Samuel Thompson, of Woburn, afterward Count Rumford, was engaged to run the levels, but the accuracy of his work was doubted by the directors, and on March 1st, 1794, Col. Loammi Baldwin was authorized to proceed to Philadelphia and secure the services of Mr. Weston, who ran the levels in July, and on August 2d endorsed the feasibility of the canal and estimated the expense at $500 000. It was decided to proceed with its construction, and Col. Baldwin, the father of three distinguished civil engineers and the discoverer of the Baldwin apple, was appointed Superintendent.

The Merrimac River flows in a southeasterly direction from New

Hampshire, and, when within about 27 miles of Boston, abruptly turns to the northeast. It was intended, by means of the Middlesex Canal, to unite this angle of the river with Boston, and provide a market for the commerce of the river.

The beginning of the canal was at a point on the Merrimac River about 2 miles above the present City of Lowell, which at that time did not exist. Its length, to the Charlestown mill-pond, the easterly terminus, was 27¼ miles. It was 30 ft. wide and 4 ft. deep; on its course were 7 aqueducts, 20 locks and 50 bridges. The Concord River was 37 ft. higher than the Merrimac and 107 ft. above tide, and was ample in volume to feed the canal in both directions. A stone guard lock was located on each bank of the Concord, with a floating tow-path between. In the Merrimac itself there were three stone locks. Many of the structures were built of timber supported on stone, and these structures, which soon began to decay, were the source of much embarrassment and expense. The canal, to-day, can be traced, but not without difficulty. Portions of it have been absorbed into highways; sewers and water pipes are laid in its bed; and, at Wilmington, the stone sides of a lock form the cellar of a house.

The water was let into the canal in 1802, and it was opened for public use in 1803.

The managers had included in their far-reaching plans the completion of the navigation of the river for 80 miles, and actually built many other smaller canals around the falls and rapids of the Merrimac. These works required the constant expenditure of money. Some idea may be had of the far-reaching views of the projectors of the Middlesex Canal when it is considered that they looked forward to a direct connection by water with Concord, N. H., and thence, by way of Sunnapee Lake, to the Connecticut at Windsor, Vt., and thence to the St. Lawrence and Canada. Their dreams, however, were destined never to be realized. The building of the Boston and Lowell Railroad parallel to the canal was the signal for its decline; it was closed in 1846 and its charter forfeited in 1859. The total cost of the canal was $613 000. The price of labor was $10 a month and board.

Inns were built along the route, where the boatmen congregated at night, as the canal was not allowed to be used after dark. Black strap, a mixture of rum and molasses, was the favorite drink of the boatmen and was sold at the price of 3 cents per glass.

It is related that Daniel Webster was engaged by the directors to plead one of their land damage cases of unusual interest, and that they paid him $100 as a retainer. As the day of trial drew near an effort was made to reach Webster, but he was always away, either in New York or Philadelphia, and the manager who told the story plaintively added: "Our one hundred dollars has gone to profit and loss account."

Some idea of the discomforts attendant on river and canal travel in the early days may be formed from the following extracts from contemporaneous sources. The first is from an advertisement, printed in Cincinnati, of the first regular packet line between Pittsburg and Cincinnati, in 1794:

"Two boats for the present will start from Cincinnati to Pittsburgh and return to Cincinnati in the following manner, viz.: First boat will leave Cincinnati this morning at 8 o'clock and return to Cincinnati so as to be ready to sail again in four weeks from this date. Second boat will leave Cincinnati on Saturday, the 30th instant, and return as above; and so regularly, each boat performing the voyage to and from Cincinnati to Pittsburg once in every four weeks. The proprietor of these boats having maturely considered the many inconveniences and dangers incident to the common method hitherto adopted of navigating the Ohio, and being influenced by a love of philanthropy and a desire of being serviceable to the public, has taken great pains to render the accommodations on board the boats as agreeable and convenient as they could possibly be made. No danger need be apprehended from the enemy, as every person on board will be under cover made proof to rifle balls, and convenient port-holes for firing out. Each of the boats is armed with six pieces, carrying a pound ball; also, a good number of muskets, and amply supplied with ammunition, strongly manned with choice men, and the master of approved knowledge."

The second extract is taken from a "Sketch of the Civil Engineering of North America," by David Stevenson, 1838:

"The canal travelling in many parts of America is conducted with so little regard to the comfort of passengers as to render it a very objectionable conveyance. The Americans place themselves entirely in the power and at the command of the captains of the canal-boats, who often use little discretion or civility in giving their orders, and strangers who are unaccustomed to such usage, and would willingly rebel against their tryanny, are in such cases compelled to be guided by the majority of voices, and quietly to submit to all that takes place, however disagreeable it may be. About eight o'clock in the

evening every one is turned out of the cabin by the captain and his crew, who are occupied for some time after the cabin is cleared in suspending two rows of cots or hammocks from the ceiling, arranged in three tiers one above another. At nine the whole company is ordered below, when the captain calls the names of passengers from the way-bill, and at the same time assigns to each his bed, which must immediately be taken possession of by its rightful owner on pain of his being obliged to occupy a place on the floor, should the number of passengers exceed the number of beds, a circumstance of very common occurrence in that locomotive land. I have spent several successive nights in this way, in a cabin only 40 ft. long by 11 ft. broad, with no less than forty passengers; while the deafening chorus produced by the croaking of the numberless bull-frogs that frequent the American swamps was so great as to render it often difficult to make one's self heard in conversation, and, of course, nearly impossible to sleep. The distribution of the beds appears to be generally regulated by the size of the passengers; those that are heaviest being placed in the berths next to the floor. The object of this arrangement is partly to ballast the boat properly, and partly, in the event of a breakdown, to render the consequence less disagreeable and dangerous to the unhappy beings in the lower pens. At five o'clock in the morning, all hands are turned out in the same abrupt and discourteous style, and forced to remain on deck in the cold morning air while the hammocks are removed and breakfast in preparation. This interval is occupied in the duties of the toilette, which is not the least amusing part of the arrangement. A tin vessel is placed at the stern of the boat, which every one washes and fills for his own use from the water of the canal, with a gigantic spoon formed of the same metal; a towel, a brush and a comb, intended for the general service, hang at the cabin door, the use of which, however, is fortunately quite optional. The breakfast is served between six and seven o'clock, dinner at eleven and tea at five."

The foregoing descriptions embrace the principal public works connected with the early history of the country. As a rule, they were unsuccessful, financially. Under the high-sounding title of "Lock and Canal Navigation," they consisted generally of efforts to improve the navigation of rivers by a removal of boulders, bars and other obstacles. Training walls and chutes were also built to concentrate the flow of the water, and often the first freshet removed all traces of the work which had been prosecuted at a considerable cost in time and money.

The primitive idea was to turn the beds of the streams into canals, and to overcome the rapids and falls by locks or inclined planes. The

latter certainly required the services of the trained engineer, and when the settlers could no longer prosecute the work without such service, recourse was had to Mr. Weston, from England, or to other foreign engineers. With financial losses, it is natural that discouragement should follow, and that several years should elapse before the struggle was renewed.

The great revival of works of internal improvement began in 1810, just before the beginning of hostilities between the United States and Great Britain, and this revival really marks the birth of engineering as a profession in this country. Up to that time, as we have seen, public works were undertaken in a spasmodic manner and without definite design. Ideas were abundant, and many of them were wonderfully far-reaching, but the means to carry them into effect, and the men to clothe them with practical form were both lacking.

The great work which was to create the new profession of the engineer was the Erie Canal. In one sense this is true, in another, the profession created the Erie Canal, for the spirit of the engineer was in the air, and would have made itself manifest in some other form. It so happened that the Erie Canal, a magnificent undertaking for its day, had the honor of being the first great pioneer work of the American engineer. We must, therefore, take a brief glance at the work itself. It will not be possible to follow the history of the canal, or to examine with any minuteness the many interesting events connected with its execution. Fortunately, they have been faithfully recorded, and can be found without difficulty. Whether one man or another is entitled to the glory of first pointing out the possibility of a connection between the waters of the Great Lakes and those of the Hudson does not enter into this discussion. We are more concerned in knowing how such a great project, with a multitude of details, all requiring the skill of the engineer, could have been carried to a successful termination in a land where there was apparently no engineer capable of the task.

Some of the preliminary surveys were made as early as 1808, but it was not until July 4th, 1817, that the actual work of construction was begun. It was finished in 1825 and opened with great pomp and parade. The total length from Albany to Buffalo was 363 miles. The canal was 40 ft. wide at the top, 28 ft. wide at the bottom, and was 4 ft. deep. There were 84 locks on the main line, each 15 ft. by 90 ft.

The total lockage was 688 ft. On the canal were 18 aqueducts, some of them fine stone structures, notably that over the Genesee River which was 804 ft. long and contained 11 arches. Among the aqueducts across the Mohawk there was one with a length of 1 188 ft. One of the embankments was 72 ft. in height. The cost was upward of $10 003 000. By the completion of the Erie Canal, the time between Buffalo and Albany was reduced from twenty to ten days.

When the Board of Canal Commissioners was created, one of the first steps taken by it was that of selecting a chief engineer. William Weston, the English engineer who had been so prominent in some of the earlier enterprises connected with canal and lock navigation in America, was urged to cross the water again and undertake the work, and was offered a salary of $10 000, but his advancing years led him to decline the offer.

With an exalted faith in the ability of their fellow-countrymen, the Commission then resolved to entrust the construction of the canal, at that time the largest and most important work of canal construction in the world, to native talent. The line was divided into three divisions, in charge of James Geddes, Benjamin Wright and Charles Brodhead, and these men, with a few able associates, took up the burden, and, with faces turned toward the future, proceeded to execute the work.

The question naturally arises—how could these men, without text books or traditions to guide them, succeed in carrying out so important an undertaking? Geddes was a judge in the county in which he resided and was 54 years of age. Wright was also a judge and had passed his 46th year. Bates and Roberts, their associates, were also judges. To understand the situation correctly we must turn backward a page. In almost every frontier settlement could be found some man, more gifted than his fellows, who laid out farms, settled petty controversies in his county and became a judge, thus uniting surveying and the execution of the law. They were generally men of courage, energy and skill, and accustomed to solving all sorts of problems. They were essentially men of action, and many of them were men whose lives had been spent in the hard school of adversity.

Benjamin Wright was born in Connecticut on October 10th, 1770. At an early age he began the work of surveying farms at Fort Stanwix, on what was then the border of civilization. Before the year 1800 it is

said he had laid out into farms more than 500 000 acres in western New York. His first work with the level was on the old Western canals, of which Mr. Weston had been the engineer. In 1803 the company decided to have some levels taken. They owned a leveling instrument, but no one could be found who knew how to use it. Judge Wright was appealed to, and after a study of the instrument and a trial, he succeeded in accomplishing the work, which led to other business for the company. What more natural than that he should have been employed in some of the preliminary work for the Erie Canal in 1811?

James Geddes was seven years the senior of Benjamin Wright. He was born in Pennsylvania on July 22d, 1763. When an appropriation of $600 was made for some of the preliminary surveys of the Erie, Geddes was selected. He made a survey from Oneida Lake to Ontario, from Lewiston to Niagara Falls, and from Buffalo to a connection with the Seneca River, all for the sum of $673, and reported that a canal from Lake Erie to the Hudson was feasible.

Canvass White, one of the junior engineers employed upon the canal, was born on September 8th, 1790, had had a fair common school and academy education, and was a man of scholarly instincts. In 1817 he left the work of construction and visited Europe for the purpose of studying canals in the old world; he traveled 2 000 miles on foot and brought back to the Erie Canal plans and instruments which were of incalculable benefit to the work. The structures built on the canal after his return were laid in cement made from rock which he discovered.

Is it at all wonderful that men such as these pushed the Erie Canal to a successful completion? They felt their way along, working out each problem, as it came, with energy and determination. What they did not understand they conquered by diligent study, unwearied zeal and sound common sense. By the constant exercise of these qualities, they laid the foundations of the profession of the civil engineer in the United States.

The action of New York in regard to the Erie Canal was the means of kindling enthusiasm in other states, and many canals were started all over the country. A large number of engineers found employment in carrying on the surveys for these works and in superintending their construction.

Besides the names already mentioned, the following engineers began

their careers on canal construction: John B. Jervis, Horatio Allen, William J. McAlpine, David S. Bates, Nathan S. Roberts, William M. Roberts, Jesse L. Williams, Major David B. Douglass, Jonathan Knight, Sylvester Welch, Ashbel Welch, Edward Miller, Samuel Forrer, James Worrall, Samuel H. Kneass, John Wilson, W. Hazell Wilson, and the list might well be extended to include others. Some of these engineers were later prominently identified with railroad enterprises, and their careers more properly belong to that era.

Canvass White, who was one of the most distinguished among the early canal engineers, became Chief Engineer of the Union Canal, and Consulting Engineer for the Schuylkill Navigation and the Delaware and Chesapeake Canal. He was Chief Engineer of the Lehigh and of the Delaware and Raritan Canals. He died in 1834 in his 44th year. With his fine abilities and character, had he been spared for a longer life, he would undoubtedly have left behind a brilliant record in the later developments of the country.

David Stanhope Bates was born June 10th, 1777. He was well educated, and was a surveyor and judge in 1810. In 1817 he began his career on the Erie Canal, and was a Division Engineer from 1818 to 1824, and the execution of some of the most important structures on that work came under his supervision. Between the years 1824 and 1829 he was in Ohio engaged in extensive works in that state, and later became Chief Engineer of the Chenango Canal and also of the Genesee Valley Canal. Judge Bates afterward became interested in railroads, and in 1835 retired, with impaired health, from the active practice of his profession. He died November 28th, 1839.

Nathan S. Roberts was born July 28th, 1776, and entered the service of the Erie Canal in 1816. He rose rapidly in his profession, and in 1828 became Chief Engineer of the Pennsylvania Canal. From 1835 to 1841 he was associated with John B. Jervis and Holmes Hutchinson in the enlargement of the Erie Canal. He died November 24th, 1852.

As a search for the fathers of the profession must, undoubtedly, be made among these early canal engineers, and it is of interest to know if among them there is one pre-eminently entitled to be designated as "The Father of the Profession," the careers of four of the most prominent have been selected for examination. They are James Geddes, Benjamin Wright, Loammi Baldwin and John B. Jervis, and their names are mentioned in the order of their birth.

In addition to his work on the surveys of the Erie Canal, James Geddes, in 1818, was appointed Chief Engineer of the Champlain Canal, and remained in charge of its construction until 1822, when he was selected to make the surveys for a canal from the Ohio River to Lake Erie, and in 1823 was called to Maine to locate a canal from Sebago pond to tide water at Westbrook. In 1827 he entered the service of the General Government on the location of the Chesapeake and Ohio Canal, and in 1828 was employed by Pennsylvania on canals in that state. He died on August 19th, 1838, at the age of seventy-five.

While Benjamin Wright was engaged upon the building of the Erie Canal, he was consulted on the Northampton, Blackstone, Chesapeake and Delaware Canals and by the State of Virginia on a proposed canal from Richmond to the Ohio. In 1824 he became Chief Engineer of the Chesapeake and Delaware Canal, and in 1825 Consulting Engineer for the Delaware and Hudson. In 1828 he became Chief Engineer of the Chesapeake and Ohio Canal, a position which he resigned in 1831. In 1832 he was appointed Street Commissioner of the City of New York, and subsequently Chief Engineer of the Hudson Railroad, and Consulting Engineer of the St. Lawrence Ship Canal, Canada, and also of the Welland Canal. Later, he was employed to survey the route for the New York and Erie Railroad, and in 1835 he was called to Havana to advise on railroad projects. During the next four years he was engaged on several canal and railroad plans, but remained principally in Virginia, to which state he had been invited after the completion of the Erie Railroad survey. He died on August 24th, 1842, being then nearly seventy-two years of age.

Loammi Baldwin was born May 16th, 1780. He was the son of Col. Loammi Baldwin, who superintended the construction of the Middlesex Canal. The son, also a colonel, was graduated from Harvard College with the famous class of 1800. In 1807 he visited England to study engineering. One of his earliest works was the construction of Fort Strong on Noddle Island. Between the years 1817 and 1820 he was employed in Virginia on various works of internal improvement. In 1821 he was appointed Engineer of the Union Canal in Pennsylvania. In 1824 he was in Europe, and it was at this time that he laid the foundation for his large library of works on engineering. From 1827 to 1834 he was employed in designing the masonry

dry-docks at Charlestown, Mass., and at Norfolk, Va., for the Government, both of these works being carried on at the same time. It was in 1834 that he made an able and elaborate report on the proposed water supply of Boston. His death occurred June 30th, 1838, at the age of fifty-eight.

John B. Jervis was born December 14th, 1795. His education was only such as could be picked up in the common schools of a new country. In 1817 he began his engineering career as an axeman on the Erie Canal, but was soon made Resident Engineer and was advanced to several responsible positions, remaining on the work until its completion in 1825. The following is a brief summary of his remarkable career.

1825–30. Chief Engineer of the Delaware and Hudson Canal.
1830. Chief Engineer of the Albany and Schenectady Railroad, and soon afterward Chief Engineer of the Schenectady, and Saratoga Railroad.
1833. Chief Engineer of the Chenango Canal.
1836. Chief Engineer of the Croton Aqueduct.
1846. Consulting Engineer of the Cochituate Water-Works.
1847. Chief Engineer of the Hudson River Railroad.
In 1850 he visited Europe, and on his return was made Chief Engineer of the Michigan Southern and Northern Indiana Railroad.
1851. President of the Chicago and Rock Island Railroad.
1861. General Superintendent of the Pittsburg, Fort Wayne and Chicago Railroad.
1864. Chief Engineer of the Pittsburg, Fort Wayne and Chicago Railroad.
In 1868 he was made one of the first trustees of the Rome Merchant Iron Mill Company.

For more than seventy years Mr. Jervis was an active worker in his profession, and at the advanced age of eighty-three he wrote a lecture on "Industrial Economy." In December, 1881, he was summoned to New York by Isaac Newton and E. S. Chesbrough in consultation on the plans for the new Croton Aqueduct. He was then eighty-six years of age. Mr. Jervis died January 12th, 1885. Owing to his wonderfully long career, I am obliged to trespass upon the fourth period of

American engineering, beginning with the formation of the engineering societies, as Mr. Jervis became a Member of this Society in 1867 and an Honorary Member in 1868.

I leave to the wisdom of the Society the selection from these four names of the one most richly deserving the title of "The Father of his Profession in the United States."

The third period of American engineering was that beginning with the introduction of railroads in 1827. As this period has been already fully described by others, it will be but briefly alluded to, and only for the purpose of completing the connection to the founding of the engineering societies.

We have seen that the judges were engineers of the early canals, and it is also true that the majors and colonels were engineers of many of the early railroads. As there was a large demand for men of technical training, the Government allowed the graduates of West Point to enter the service of the railroads, and thus it happened that engineers with military titles, and sometimes with the organization of the brigade, could be found laying out the locations and superintending the construction of the early lines. William Gibbs McNeill, George W. Whistler and John Childe were officers in the army. On the other hand, Horatio Allen, Jonathan Knight, Benjamin H. Latrobe, Moncure Robinson and William Milnor Roberts were from civil life.

The early conceptions of Oliver Evans, John Stevens and Robert Fulton, and also the old colliery and quarry tramways were preliminary steps to the advent of the railroad. In 1825 William Strickland was sent to England by a number of public-spirited citizens of Philadelphia, and he made some interesting reports. The famous Quincy Railroad was built by Gridley Bryant in 1826, but it was only 3 miles long, and, like all the first railroads, was built as a horse railroad. It was followed in 1827 by the Mauch Chunk road, 9 miles long, connecting the mines with the Lehigh River, which, like several other tramways, was simply an adjunct to a canal. It is worthy of note that within ten years from this time there were no less than 56 railroads in active operation in the United States.

The first railroad of importance was the Baltimore and Ohio. It occupies the same position among the railroads that the Erie Canal occupies among the pioneer canals. It was incorporated in 1827, a corner stone was laid on July 4th, 1828, and the railroad was practi-

cally opened in 1830. It was completed to Harper's Ferry, 82 miles from Baltimore, in 1834, at a cost of $4 000 000. It was constructed for the use of horses as a motive power, and it was only after much experimenting that locomotives were introduced. The roadbed was formed with granite sills plated with flat iron bars, which had an uncomfortable way of curling up under the traffic, and were called "snake heads"; occasionally they would break off and come up through the floors of the cars. Although every roadbed from that time to the present has been a source of trouble and expense for maintenance, the term "permanent way" was used at an early date, and is still used to describe what is actually far from permanent in construction.

Jonathan Knight and Colonel Stephen H. Long made the first survey for the Baltimore and Ohio Railroad, and Jonathan Knight was the first Chief Engineer. He was without special education, but was a man of remarkable mental capacity. He was one of the old farmers and surveyors who worked his way to the highest station by unremitting toil and the exercise of sturdy and manly qualities. In 1842 Knight resigned his position and retired to his farm, but was afterward employed as a consulting engineer. Benjamin H. Latrobe succeeded Mr. Knight as Chief Engineer of the Baltimore and Ohio, and was among the most distinguished of the railroad engineers.

Captain John Childe, born 1802, died 1858, was a consulting engineer on the Baltimore and Ohio Railroad with Knight and Latrobe, and, like his associates, left a long record of works accomplished in various directions. His own words were, "This is a glorious world and there is much to do in it."

Horatio Allen, born 1802, died 1889, was one of the Nestors of railroad construction in this country. He was first associated with Benjamin Wright on the Chesapeake and Delaware Canal in 1824, and afterward became an assistant to John B. Jervis on the Delaware and Hudson Canal. In 1827 Mr. Jervis gave his assistant leave of absence to visit Europe, and in England Mr. Allen made the acquaintance of George Stephenson, and finally purchased three locomotives which he brought back with him. One of these, the Stourbridge Lion, he put together and ran on the Delaware and Hudson Railroad in 1829. This was the first locomotive ever tested on an American railroad.

In 1829 Mr. Allen was made Chief Engineer of the South Carolina Railroad, which he designed for a steam railroad, the first in the

world intended for locomotives, and the first long railroad built in the United States. It extended from Charleston to Augusta, Ga., 136 miles. The first hundred miles of railroad iron ever laid in one continous line was laid on this railroad.

From 1834 to 1837 Mr. Allen was abroad, and on his return was engaged as Principal Assistant Engineer on the Croton Aqueduct, and afterward became one of the Croton Commissioners. In 1842 he became one of the proprietors of the Novelty Iron Works, and was President until 1870. He was President of the New York and Erie Railroad and its Consulting Engineer. Mr. Allen was also Consulting Engineer of the Panama Railroad, and his last official position was that of Consulting Engineer of the East River Bridge. Mr. Allen became a Member of this Society in 1867, was President from 1871 to 1873, and became an Honorary Member in 1874.

One of the most distinguished of the early railroad engineers was William Gibbs McNeill, of North Carolina. He was graduated from the Military Academy in 1817. He was employed upon the Chesapeake and Ohio Canal, 1824, the Baltimore and Ohio Railroad, 1827, and the Baltimore and Susquehanna, 1830. He resigned from the army in 1837, with the rank of major by brevet. He was either Chief Engineer or Assistant Engineer of the following railroads: Paterson and Hudson, Boston and Providence, Providence and Stonington, Taunton and New Bedford, Long Island, Western of Massachusetts (now the Boston and Albany), and others. In 1842 he put down the Dorr Rebellion in Rhode Island and was made a Major-General of the militia. He died February 16th, 1853.

George W. Whistler, born May 19th, 1800, was graduated from West Point, and in 1828 was sent to England with McNeill and Knight in behalf of the Baltimore and Ohio Railroad. He was employed on several other roads, and in 1833 resigned from the army. In 1834 he became Engineer for the Proprietors of Locks and Canals, Lowell, Mass., and later aided McNeill in constructing the Western Railroad of Massachusetts. In 1842 Whistler went to Russia to build the road from St. Petersburg to Moscow, and died in that service April 7th, 1849. Whistler's fame added fresh laurels to the profession of engineering. One of his sons is the distinguished artist, James A. McNeill Whistler, of London.

Among other engineers who attained celebrity in this branch of the

profession were James E. Williams, William Milnor Roberts (a statement of whose remarkable career may be found in the records of this Society), James Laurie, Moncure Robinson, J. Edgar Thomson, James P. Kirkwood, William J. McAlpine, Ellis S. Chesbrough, and others whose names deserve mention, but their lives and works, as a rule, have been either recorded in the biographies of the Society or they encroach upon a later period of engineering.

The venerable W. Hazell Wilson, now living, was among the early engineers employed upon the Baltimore and Ohio Railroad, and he has written some of the most interesting accounts of the pioneer railroads. Mr. Wilson's father was an old canal engineer, and his grandfather and great grandfather were employed in engineering pursuits. Mr. Wilson's sons, the Wilson brothers of Philadelphia, are prominent in the profession, and their sons are now entering the field, so that we have in connection with this family of engineers, the noteworthy spectacle of six generations, in direct descent, engaged in the same profession, and five generations in this country.

No notice has been taken of the work of the bridge builders, but they should not be forgotten. As early as 1792 Timothy Palmer began to build bridges over some of the largest rivers. In 1806 he completed the Philadelphia Bridge over the Schuylkill. Mr. Weston designed the coffer-dams for the piers, which were in deep water. At about this time Theodore Burr and Louis Wernwag began to build long-span wooden bridges, in which they accomplished some remarkable work. They were followed by Squire Whipple and that meteoric genius, Charles Ellet, Jr., whose assistant, John A. Roebling, designed the grand suspension bridges so well known to the profession. An interesting historical *résumé* of the early bridges will be found in Mr. Theodore Cooper's able paper on "American Railroad Bridges," published in the *Transactions* of this Society in July, 1889.

The foregoing review has been prepared for the purpose of giving in connected form an idea of some of the most noteworthy among the earliest public works of the civil engineer, with brief outlines of the lives of the fathers of the profession in the United States.

There is much to be gained from a careful consideration of the important work accomplished by these noble and self-sacrificing men, who, in the face of almost insurmountable difficulties, successfully laid the foundations for the commanding position which

the profession now enjoys. Some of the works which they created have long since been swept away in the advance of population, others have been absorbed in the larger developments of succeeding generations, but many still survive as living monuments to their constructive skill. In any event, the heroic struggles and the masterly achievements of the early engineers are deeply engraved in the history of every undertaking which their busy brains designed or their willing hands executed. This is due largely to the disinterested nature of their services, which were directed to the welfare of the public rather than to the advancement of their own glory. Even their lives were sometimes sacrificed to the sense of duty. They sowed and others have reaped the harvest from their honest and faithful toil. No eulogy we can pronounce upon their lives will add to the luster of their fame, but it will aid us to recall the debt of gratitude we owe to our predecessors. However permanent, however useful, however grand the engineering works of the present day may be, their success is due to the failures and successes of the works that have preceded them. In these closing hours of the nineteenth century, which has witnessed the rise and progress of the civil engineer in America, we may well glance backward to gain fresh inspiration from the courage, devotion and achievements of the early founders of the profession. A just pride in their work will lead us to emulate their example and to be faithful in our day and generation to the inheritance derived from their talents and industry.

MEMOIRS OF DECEASED MEMBERS.

DAVID LEONARD BARNES, M. Am. Soc. C. E.*

DIED DECEMBER 15TH, 1896.

David Leonard Barnes was born in Smithfield, R. I., August 23d, 1858. When he was but eleven years old his father died, and the young man was led thus early in life, to the exercise, in a serious way, of self-reliance and responsible judgment. At the age of fifteen he entered a civil engineer's office in Providence, where his work included town surveys and the laying out of streets. His mind, however, was set upon obtaining an education better than that afforded by the routine of a surveyor's office, and he spent the three years following 1876 in Brown University and the Massachusetts Institute of Technology as a special student, while the vacations were occupied in engineering work. He received the degree of Master of Arts from Brown University, but took no degree from the Institute of Technology. Although surveying and municipal work were his earliest engineering employments, both the bent of his mind and his special studies inclined to the mechanical side of civil engineering, and it was in this that his reputation was won. He served three years following 1879 in the machine shops and drafting rooms of the Rhode Island Locomotive Works, at Providence, R. I., and the Hinckley Locomotive Works, Boston, Mass. He was Chief Draftsman at the Rhode Island Works when, in 1884, he left to become the Mechanical Engineer and Chief Draftsman of the New York Locomotive Works at Rome, N. Y., which were built in that year. Returning to Providence he passed three more years as Chief Draftsman and Mechanical Engineer of the locomotive works with which he had begun his mechanical practice.

Mr. Barnes had now become well known as a designer of railway rolling-stock and an authority on many other matters connected with railway operation, and in 1888 he entered upon consulting practice, with offices in Chicago, Ill., and New York City. During his service in the locomotive shops he had designed and superintended the construction of about 800 locomotives, and also a large number of stationary and steamboat boilers and special tools. At the Rhode Island works he had planned and supervised the construction of dynamos and electric motors for street railway equipment, and designed the shops of the Boston and Maine Railroad. The shops of the Bentley-Knight Electric Railroad Company were completed, fitted up, equipped

* Memoir prepared by the Secretary from papers on file and from various sources.

and put in operation under his direction. The equipment of the Allegheny, Pa., Electric Street Railway was also designed under his supervision. At the Rome works, Mr. Barnes designed, purchased and superintended the construction of a large part of the machinery installed, as well as of the first locomotives built at the works. Other work of a general character included the design, for the Providence Ship Windlass Company, of steam windlass and hoisting gear for the United States Government. In 1888 he became consulting engineer to the *Railroad Gazette*, New York City, a relation which was later broadened to engagement as mechanical editor, which connection was maintained until his death.

Mr. Barnes' work as a consulting engineer included designs, tests, inspection and reports covering the whole range of railway rolling-stock and operating devices, manufacturing plants, iron-work for buildings and steam-engine construction. He was engaged as consulting engineer by the London Central Subway Railway and by the New York Underground Railroad. The Chicago and South Side Rapid Transit Railroad, known as the Alley Elevated, retained him to have general supervision of the design and construction of its rolling equipment, signaling, lighting and shop plant. He made a radical departure from the current practice on elevated railways, by introducing, in 1893, compound locomotives on the Chicago line. When the Baldwin Locomotive Works and the Westinghouse Electric and Manufacturing Company decided to join forces in an endeavor to realize the union of the essential features of the standard steam locomotive and the accepted practice in the arrangement of mechanism for electric traction, Mr. Barnes was engaged to take charge of the work. He entered upon this labor with enthusiasm, and the designs produced have been commended for their robust simplicity and adaptability to the work required.

Mr. Barnes was endowed with unusual strength and energy, both physical and mental. He was, by nature, a mathematician, and had strong powers of analysis and reasoning. He found pleasure in the discussion of technical questions, and his arguments were marked by a directness of address to the main issues, which irrelevant details were never allowed to obscure. He had the scientific love of truth, and his published work was of a nature to stimulate his fellow engineers to thought and effort. A rapid and systematic worker, in addition to his editorial labors for the technical press, he made many contributions to the publications of the Master Car Builders' Association, the Master Mechanics' Association and the Western Railway Club, and his work included numerous reports on locomotive and car construction, and on electricity as a motive power for railroads. He carried to completion a revised edition of "Compound Locomotives," taking up the work after the death of Arthur Tannatt Woods, the author, and

about a year before his death he wrote a book on "Electric Locomotives."

Mr. Barnes became a Member of the American Society of Civil Engineers, July 2d, 1890. He was also a Member of the American Society of Mechanical Engineers, an Associate Member of the Institution of Civil Engineers, a Member of the Engineers' Club of New York and of various societies of railroad operating officers. He was married April 7th, 1896, to Ida, daughter of Colonel B. J. D. Irwin, U. S. A. (Retired), formerly Assistant Surgeon-General. In the summer of 1896 Mr. Barnes relaxed business engagements for a trip to Europe in hope of improved health, but was soon obliged to return for medical treatment. During the summer his strength steadily declined, but he did not cease work until two weeks before his death.

THOMAS SPARKS BISHOP, M. Am. Soc. C. E.*

DIED NOVEMBER 13TH, 1898.

Thomas Sparks Bishop was born March 12th, 1846, near Columbus, Burlington County, N. J. His father was a farmer, and his early educational facilities were such as were usually afforded by the ordinary country public and private schools. Before entering college he was a pupil at Westtown Boarding School near Westchester, Pa.

He entered the Philadelphia Polytechnical College September, 1864, and was graduated as Civil Engineer in June, 1866. The Master's degree was conferred upon him in 1869. Early in the succeeding August he was appointed Rodman on the engineer corps of the Camden and Amboy Railroad, and was engaged in the location and construction of the Pemberton and Hightstown, and Camden and Burlington County railroads until their completion, about a year and a half later.

In March, 1868, he was appointed Assistant Engineer of the Freehold and Squankum Marl Company's Railroad, after the location of which, in June of that year, he was recalled to the main line of the Camden and Amboy Railroad in the capacity of Assistant Engineer. In addition to his other duties there, he had charge, until January, 1872, of the location and construction of various branch railroads. During this time, however, he was detailed as Resident Engineer to take charge of the construction of the inclined plane machinery, etc., of the Bingham Mining and Lumber Company at Renovo, on the Philadelphia and Erie Railroad, where he was engaged from September to December, 1868.

In January, 1872, after the lease of the works of the United Companies by the Pennsylvania Railroad Company, he was appointed Assistant Engineer of Construction on the United Railroads of New Jersey Division, and in December of that year was assigned as engineer in charge of the improvements at Harsimus Cove and Bergen Hill, at Jersey City. Upon their completion in January, 1875, he was transferred to Trenton, N. J., where he made re-surveys of the various railroads of the United Railroads of New Jersey Division for the real estate and maintenance of way departments, until May, 1880, when he resigned to accept an appointment as engineer with the Russell & Erwin Manufacturing Company at New Britain, Conn. He served in that capacity for eighteen years, resigning his position June 1st, 1898, to devote his attention to private practice as a civil engineer and surveyor, with headquarters at New Britain, Conn.

Mr. Bishop was married in November, 1873, and was elected a Member of this Society September 2d, 1885.

* Memoir prepared by T. Sparks Bishop, Esq., from autobiographical data left by his father.

FRANCISCO JAVIER CISNEROS, M. Am. Soc. C. E.*

DIED JULY 7TH, 1898.

The name of Cisneros is an old and honored one in Spain and Cuba, each generation adding to its luster, through various channels, literature, science, or patriotism. The founder of the Cuban branch of this family was Pascual Jimenez de Cisneros, a distinguished Spanish military officer, who emigrated to Cuba in 1763, marrying there about six years later. Hilario Cisneros y Saco, the father of Francisco Javier, was a jurist whose fame for sterling integrity of character and for patriotism still endures in the memory of the Cubans.

Francisco Javier Cisneros was born at Santiago de Cuba in December, 1836, receiving his earlier education in that city. From there he went to Havana, pursuing his studies at the more advanced school of José de la Luz y Caballero, and later at the University of Havana, where he was graduated with high honors in April, 1857, receiving the degree of C. E.

His first experience was obtained as Assistant Engineer on the surveys of the railroad from La Mulata to Pinar del Rio, near the northerly coast of Cuba. In the following year, 1858, he was employed as assistant on the construction of the Sagua-la-Grande Railroad. Subsequently he was engaged on the construction of a branch of the Savanilla Railway, and on the completion of the latter he assumed charge of the construction of a portion of the Cardenas Railway. Immediately after the termination of this work, he was appointed to the position of Engineer in Charge of the Ferro-carril del Oeste, running from Havana to Pinar del Rio. He finally became General Manager of this road, which position he retained until 1867.

Always mindful of his country's welfare, and viewing the tyrannical rule of Spain with the natural repugnance of a spirit embued with the love of liberty and independence, Mr. Cisneros commenced early to use his endeavors toward the amelioration of the political evils. A party having been formed among patriotic Cubans to further liberal reforms in the government of Cuba—reforms which the more cultured class were persistently demanding, Mr. Cisneros became an active spirit therein, and in 1867 assumed the management of the periodical *El Pais*, devoting all the efforts of his caustic pen to the denunciation of Spanish misrule, and the espousal of liberty. Under the pretext of establishing agencies for the paper, he visited all parts of the island, thus directly coming in contact with the advocates of home rule and independence, and thereby laying the foundation for the Revolution of Yara, which broke out in October, 1868. From that date until

* Memoir prepared by Theodore A. Leisen, M. Am. Soc. C. E.

1871 all his energies and resources were dedicated to his country's cause. He personally arranged and conducted seven successful filibustering expeditions from the United States to Cuba, and also in the field lent his services to the struggle against Spanish rule. During this period he found opportunity to contribute many inspiriting articles to the Cuban revolutionary periodicals, and he also wrote several professional papers.

In 1871, forced through lack of consistent co-operation to desist from farther active work in behalf of Cuban independence, Mr. Cisneros decided to take up his residence in New York, and pursue his profession, at the same time declaring his intention of becoming an American citizen—a citizenship of which he was always proud. Coincident with his return to New York he, in partnership with Mr. A. G. Menocal, opened an office at 115 Broadway, and carried on a general engineering practice until his departure for South America.

About this time, when the controversy between the advocates of broad and narrow-gauge railroads was at its height, Mr. Cisneros prepared and read a paper before the New York Society of Practical Engineers, of which he was a member, strongly supporting the claim for narrow-gauge roads for new and undeveloped countries, such as the South American Republics. This article, with some additions, was published later in both English and Spanish, and attracted considerable attention, particularly in South America.

During 1871–72, Mr. Cisneros was commissioned by the Government of Peru to make a detailed inspection of the proposed Ferrocarril del Cerro de Pasco, and report thereon, and this work was performed to the entire satisfaction of that Government.

Toward the latter part of 1873, the Government of the State of Antioquia, United States of Colombia, requested Mr. Cisneros to assume charge of, and construct, the proposed railroad from Puerto Berrio, on the banks of the Magdalena River, to Medellin, since known as the Ferro-carril de Antioquia. Previous to this time narrow trails or mule roads were the sole avenues for transportation, and the railroad was designed to open up and develop the rich mining fields of Antioquia. Mr. Cisneros undertook the task assigned to him, entered into a contract with the Government of Antioquia, made the necessary reconnoissance and preliminary surveys, and commenced the construction of the road. In this work seemingly insurmountable difficulties were encountered and overcome, and in view of the existing conditions it was an accomplishment under which a man of less indomitable energy would have succumbed. Just as the first section of the road from Puerto Berrio to Pavas was completed and opened to traffic, the country was thrown into a state of revolution, and during the attendant turmoil the terms of the contract with Mr. Cisneros were ignored, and the road was seized for military purposes. Mr. Cisneros therefore refused to proceed

with the work, the contract was rescinded, and the road was turned over to the Government.

In 1877, at the request of General Julian Trujillo, President of Colombia, Mr. Cisneros agreed to assume charge of the construction of the Cauca Railway, projected from Buenaventura, on the Pacific Coast, to Cali, and in January, 1878, commenced the preliminary surveys. The actual work of construction was started later during the same year. Mr. Cisneros had in view, as an ultimate object, the joining of this with the Antioquia Railway, but this project never reached farther than the preliminary surveys. The work on the Cauca Railway was interrupted after about 30 miles had been built, by the same revolutionary movement which stopped the work in Antioquia, and, the same conditions prevailing, this contract was likewise rescinded.

In 1881, Mr. Cisneros entered into a contract with the Government of Colombia to carry on the construction of a section of the Ferro-carril de Girardot, which had been projected from the head of navigation on the Upper Magdalena River, to Bogota. During the same year, under a special arrangement with the Government, and by direct order of the National Congress, he assumed charge of the construction of the Ferro-carril de La Dorado, connecting the navigable waters of the Lower and Upper Magdalena Rivers. This road was completed from Las Yeguas to a point a few miles above Honda, after which Mr. Cisneros disposed of his interests therein.

In 1884, Mr. Cisneros, by purchase, secured control of the Ferro-carril de Bolivar, running from Barranquilla to Salgar, and shortly afterward commenced the extension thereof to its present terminus at Puerto Colombia. A syndicate, known as the Barranquilla Railway and Pier Company, Limited, was formed in London to control and operate this road, Mr. Cisneros remaining in charge as Managing Director up to the time of his death. Under his management both road and traffic were steadily built up and improved. In 1892 he constructed a steel pier 4 000 ft. long at Puerto Colombia, the ocean terminus of the road, extending out into the harbor to about 5 fathoms of water, thus enabling all ocean steamers, which formerly were compelled to lighter their cargoes ashore, to discharge directly into cars.

Mr. Cisneros was also engaged in many other important enterprises in the Republic of Colombia. He expended considerable labor in canalizing the Upper Magdalena River, deepening and clearing the channel at all the dangerous points, opening this portion of the river to steam navigation where formerly only canoes and barges were used, and doing much besides to improve navigation on the Lower Magdalena. He also established lines of steamers on the Upper and Lower Magdalena. He was chiefly instrumental in organizing the Colombian Transport Company, which operated jointly all the steamers on this river and its branches, and for a time he acted as Director General of

the company. He constructed and operated the Barranquilla Tramway, and had large interests in the Ferro-carril de Cucuta.

During the past twenty-five years, the development of Colombia has been largely influenced and accelerated by Mr. Cisneros, and it is seldom that a country's prosperity owes so much to the efforts of one man. His endeavors in that field were not toward personal aggrandizement, but for steady development of the enterprises under his management, and, consequently, an equal development of the country's resources. Ultimately, the government and people of Colombia appreciated this fact. Their confidence in him was most recently evinced by selecting him to defend their interests in a controversy between the Cauca Railway Company and the Colombian Government, which was submitted to arbitration in New York. It was due to his management of the case, and to the firm stand which he took, that the Government of Colombia was not forced to submit to one more unjust award to a foreign corporation.

Mr. Cisneros was an indefatigable worker, undaunted by difficulties or reverses, allowing no obstacles to swerve him from his pre-determined path. As a man and a friend he had no peer. With broad ideas of justice, chivalrously considerate of those associated with him, asking of no one what he was not willing to undergo himself, kind and sympathetic, he endeared himself to all who were brought into close contact with him—a man whom it was a privilege to know, an honor to call a friend.

Mr. Cisneros became a member of the American Society of Civil Engineers on May 15th, 1872, and of the Institution of Civil Engineers, London, on February 5th, 1884.

ALBERT FINK, Past-President, Am. Soc. C. E.*

DIED APRIL 3D, 1897.

It is given to few engineers to achieve greatness in more than one specialty. The profession now comprises so many branches that few can reap distinction in more than one particular. Some become eminent as investigators, or as constructors, or as managers, but the capacity to excel in all those directions is seldom found in the same man. But it can be said of the late Albert Fink, who was President of this Society from November 5th, 1879, to November 3d, 1880, that in the early part of his career he ranked as the leading bridge engineer of this country. Later he made a great reputation as an investigator of railroad economics, and as a railroad manager under exceptional difficulties; he gained still higher fame as a statesman, directing an association of railroads, and making most valuable contributions to the rational solution of the railroad problem.

The following is the bare skeleton of dates furnished by Mr. Fink himself to the "Biographical Directory of the Railway Officials of America," when asked by the *Railway Age* of Chicago for a sketch of his career:

"Born Lauterbach, Germany, October, 1827. Entered railroad service December, 1849. To October, 1853, Assistant to Engineer, Baltimore and Ohio Railroad, in charge of bridge and depot construction, west of Cumberland. October, 1853, to August, 1855, Resident Engineer, Parkersburg Branch, Baltimore and Ohio Railroad. August, 1855, to July, 1857, Division Engineer, same road; also Consulting Engineer, Norfolk and Petersburg Railroad. July, 1857, to October, 1859, Assistant Engineer, Louisville and Nashville Railroad; October, 1859, to October, 1865, Chief Engineer and Superintendent of road and machinery department. October, 1865, to July, 1870, General Superintendent, and July, 1870, to October, 1875, Vice-President and General Superintendent, same road. 1872 to 1875 also Vice-President South and North Alabama Railroad Company. October, 1875 to May, 1876, Commissioner Southern Railway and Steamship Association. June, 1877 to date (1889), Commissioner Trunk Line Association. Office, New York City."

This gives a most inadequate idea of the achievements of this distinguished engineer, and even this memoir must fall far short of fully presenting his great abilities and eminent services to his adopted country.

Albert Fink received his early education in his native town in a private school, in which boys were prepared for the university course, much attention being there paid to the study of Latin and Greek. His father was an architect, and, as Albert evinced a desire to follow this profession, he was sent to the polytechnic school at Darmstadt, where he took a course in engineering and architecture, graduating with high

* Memoir prepared by O. Chanute, Rudolph Fink and H. G. Prout, Members, Am. Soc. C. E., Committee appointed by Board of Direction.

honors in 1848. From there he went to Offenbach, near Frankfort-on-the-Main, entering the service of a contracting firm engaged in the construction of public buildings, factories and dwellings, and there he gained much practical experience in his profession. The German Revolution of 1848, in which, as an ardent lover of freedom and a firm believer in democratic institutions, he took a deep interest, proving a failure, and the consequent reaction producing a most unfavorable condition of things, he decided to emigrate to America. He returned to his home early in 1849 to prepare himself for the important step he was about to take, by thoroughly reviewing his polytechnical course and by studying the English language. He was already exceedingly systematic, and made for himself a schedule of daily studies, allowing nothing to distract him from the performance of the task he had imposed upon himself, being fully determined to omit nothing that he could do to achieve success in life.

In the spring of 1849, the year in which so many young Germans left their fatherland, he came to America. Few men were better equipped than he for the battle of life, and none had more courage to engage in it. Nevertheless, he found much difficulty in getting a start, and his courage, patience and power of endurance were severely tried before he finally succeeded in obtaining congenial employment. In New York, where he landed, he was unable to do so, but soon after his arrival in Baltimore he had the good fortune to get a position in the drafting office of Benjamin H. Latrobe, one of the first great engineers this country produced, who was the Chief Engineer of the Baltimore and Ohio Railroad, then under construction.

In those days engineers and draftsmen who could make original designs were not as plentiful as now, and such work fell almost entirely upon the chief engineer. So it was natural that Albert Fink's thorough schooling and his practical experience should cause him to soon attract Mr. Latrobe's favorable attention and cause his rapid promotion. It was not long before he became Mr. Latrobe's principal assistant and was put in charge of designing and building bridges, stations, shops, etc., for the new road between Cumberland and Wheeling, a position which he retained until the completion of the line, in 1853. During this time he produced some of his best engineering works and invented his well-known truss, which enabled him to increase considerably the length of span in iron bridges.

His first design on this plan was the bridge over the Monongahela River at Fairmont, W. Va., consisting of three spans of 205 ft. each, built in 1852, this being then the longest iron railroad bridge span in this country.

The immediate cause of the invention of this truss was the desire to avoid building many masonry piers in a large river subject to sudden rises, which would have greatly delayed the opening of the road

for traffic, and the desire to secure an iron bridge with less material than the "Bollman" truss* would have required for the same length of span.

The Fink truss is chiefly remarkable for its great simplicity. The strains in each member can be readily ascertained without intricate calculation, and they are always either compressive or tensile, there being no member subjected to both these strains alternately, while proper provision is made so that no injurious effects are produced by expansion and contraction caused by changes in temperature or by variable loads.

The Monongahela Bridge was a through bridge with cast-iron chords and posts and wrought-iron tension rods, with pin connections throughout. The ends of the chords were hung by links upon pins in cast-iron towers, and the floor beams were hung by suspension links to the pins connecting the tension rods with the posts—thus allowing all parts of the truss to expand and contract without deranging the structure. Once properly erected no subsequent adjustments were ever necessarry on such a bridge. The plan was promptly adopted by Mr. Latrobe for all the bridges on the Baltimore and Ohio Railroad and the Parkersburg Branch.

About the same time Albert Fink built two cast-iron high viaducts of novel design. They were erected upon a steep mountain grade and upon sharp curves, and were considered bold structures and were much admired. When the Society held its Annual Convention at Deer Park, in 1885, the Baltimore and Ohio Railroad officials took the members in a special train to view these viaducts, which were at that time still in good order.

Besides bridges and viaducts he furnished designs for stations, shops and engine houses, which were all characterized by appropriateness, neatness in appearance and by economy in the use of materials.

All these works made a considerable reputation for him, and when the Baltimore and Ohio Railroad was completed he might have rested on his laurels and turned his attention to the general introduction of his patent bridge-truss and to the accumulation of wealth. The time for this was most propitious, and he could readily have obtained the needful capital, for there was no probability of failure; but he was not inclined to follow such a course; he was ambitious to learn more and to perfect himself in his profession. So he accepted the position of Resident Engineer on the construction of the Parkersburg Branch, taking charge of the first seven miles from Grafton west. Mr. Latrobe

* The Bollman bridge was also designed by an employee of the B. & O. R. R. The Fink truss proved so superior that it came into extended use, and shops were built in Louisville for its manufacture. Many of the bridges on the L. & N. R. R. were of this type. In 1860 Mr. Fink was considered the leading bridge engineer of the United States. When in 1865 the North Missouri Railroad invited designs for the first bridge to be erected over the Missouri, the plans of Mr. Fink received the second prize. He had in the meantime designed, besides many other structures, the great iron bridge across the Ohio River at Louisville, which was begun in 1867 and completed in 1870.

was Chief Engineer and put him also in charge of the bridges and buildings. Here he made himself familiar with the use of the level and transit, and with graduation and masonry work, remaining from October, 1853, to August, 1855, when he was appointed Division Engineer of the Western Division of the same road, where he remained until its completion in 1857.

During this time he served also as Consulting Engineer of the Norfolk and Petersburg Railroad, then building under William Mahone, to whom he furnished the designs for the principal bridges and buildings on that line.

His business connections with Mr. Latrobe now terminated. Their relations had always been most pleasant, and they had formed a warm friendship which continued until death.

In July, 1857, Albert Fink went to the Louisville and Nashville Railroad as Assistant Engineer in charge of buildings and bridges—under George MacLeod, Chief Engineer. He was then in his thirtieth year and in the prime of life, with a capacity for work such as few men ever had. Though fully occupied with designs for the Louisville and Nashville Railroad he found time to prepare plans for rebuilding the Louisville Court House (in 1858) which were adopted, he being appointed to superintend their execution. In this work he displayed his talent and taste as an architect, and it added much to his reputation. The edifice is to-day the finest in the city, if not in the State, and the pride of the people of Louisville.

The Louisville and Nashville Railroad was opened through to Nashville in November, 1859. It was still very incomplete, it being estimated that nearly $1 000 000 was yet to be expended to make it a first-class road. In October, 1859, Mr. Fink was appointed Chief Engineer and Superintendent of the Road and Machinery departments. In 1861 the Civil War broke out, and there followed an experience in railroad operation, for four or five years, too dreadful, as we now think, ever to occur again. The line of road under Mr. Fink's charge ran directly through the region most affected by the contending armies in Kentucky and Tennessee, and was alternately in possession of the Confederate and Federal forces. The former first seized, in July, 1861, the 45 miles of the road in Tennessee, with its rolling stock, and in September further took possession of all the southerly portions of the line to within 30 miles of Louisville, leaving but 67 miles out of 268 which could be operated by the company. The Federal forces then advanced and the Confederates retreated southward, but while falling back they destroyed many of the bridges, either by burning them or blowing them up, burned the depots, the machine shops, the engine houses and the water stations. They tore up many miles of track, piled up the ties and burned them after having placed the rails on top, so that the latter were badly bent, and carried off

such of the rolling stock as was not in the ditch, so that the line was strewed with wrecks from one end to the other. Mr. Fink lost no time in waiting for the Federal forces to protect his workmen. He followed up the retreating Confederates with tireless energy, reconstructed the damaged portions of the road, trestled the bridges,* built temporary water stations, straightened the rails and relaid the track, and picked up the wrecked engines and cars. This work was seriously interrupted by local freshets, which washed out some of the trestles, sometimes more than once, but, to the amazement of the military, these reconstructions were completed nearly as fast as the Federals advanced, and not infrequently ahead of them. So adequate was this reconstruction and the subsequent operation that the Louisville and Nashville was the only road in the South of which the Federal authorities did not take military possession, having realized that it could be repaired and operated by Mr. Fink more efficiently than by themselves.

The Louisville and Nashville Railroad was the base of supplies for the Federal forces. Over that line all supplies had to be hauled, and it became an important object for the Confederates to destroy or cripple it. Then ensued a series of many raids, which became celebrated as those of General John N. Morgan. This dashing cavalry officer slipped through the Federal forces many times, made his way north to the line of the road, captured trains and burned them, destroyed bridges and water stations, and repeatedly stopped entirely the operations of the road. By that time Mr. Fink had organized, with great forecast, a special corps of bridge builders, bold, sturdy fellows, with which he repaired the damages as soon as the raiding forces withdrew. Indeed, in some cases, too soon, for the raiders turned back upon their tracks, drove off the repair gangs and occasionally killed some of the men. A number of times Mr. Fink's own life was in danger. Some bridges were burned three times—a tunnel was caused to cave in by burning the timbering; trains were wrecked, and indeed every class of injury was done which could be inflicted on a railroad. This continued for about three years, and was followed by minor raids of predatory bands and guerillas, there being no less than 8 detailed in the report of 1864, and 22 in the report of 1865, in which trains were captured, depots, cars, bridges and trestles were burned, and a number of the employees killed, the total amount of physical damages being estimated by Mr. Fink (report of 1866) at $689 512.39, without including the loss of traffic or the increased operating expenses. These damages were repaired with wonderful speed and vigor, although complicated by an unprecedented storm in 1865, which washed away many embankments and bridges, and stopped the operations of the road for a week. Moreover, Mr. Fink carried forward, as opportunity and means

* One of them was an iron structure 1 000 ft. long and 115 ft. high, two spans of which had been blown up, while another was 520 ft. long and 92 ft. high.

served, the work of completing the construction of many works left unfinished at the first opening of the road, so that it was in prime condition at the end of the Civil War, and did a large and profitable business as a consequence of this wise forecast.

In his annual reports, which were models of their kind, and soon overshadowed those of the directors and of the operating department, Mr. Fink dispassionately recited the destructions and misfortunes of the preceding fiscal year, together with detailed estimates of the cost of the damages inflicted. He confined himself to a calm statement of the facts, and a characteristic foot-note* in the report of July 1st, 1863, added just as it went to the printer, exhibits with what fortitude he neither allowed himself to be cast down by fresh misfortunes, nor elated by good luck.

Amid these vicissitudes he inaugurated and maintained the admirable system of accounts and records which enabled him to determine the cost of every item of work, and which subsequently attracted so much attention from railroad men. He was made General Superintendent (in addition to his duties as Chief Engineer) in 1865, and every report of the president and directors drew special attention to his efficiency and good management.

With the return of peace, Mr. Fink devoted his great energies to the reorganization and economical operation of the road. Not only did he repair the damages inflicted during the war, complete the temporary works of the original construction, and put the line into high condition, but he also made the first thorough investigation ever carried out in this country into the cost of railroad traffic, and the steps to be taken to produce the best results. Trained to accuracy as an engineer, he investigated the expense, through his system of accounts, of the various particulars of the traffic, and introduced science in making the tariffs. Up to that time railroads had been operated mostly by rule of thumb, and little attention had been paid to the actual cost of various classes or items of the traffic. The Louisville and Nashville Railroad in 1866 consisted of a main stem of 185 miles and three branches of 85, 46 and 17 miles, respectively. On these the cost of the same traffic differed very greatly, in consequence of its volume and of the local circumstances. Mr. Fink investigated the causes and remedies for this difference with great acumen. This was done by classifying the operating expenses under some seventy-five different headings, by making up statements of the amount and character of the freight and passenger traffic, and by reducing the accounts

* That foot-note was as follows: "Since then Morgan has visited the road once more. On the 4th of July he captured Lebanon, completely demolished the company's depot buildings and engine house at that place, burned all the cars standing there, and also Hardin's Creek bridge, 2½ miles this side of Lebanon. On the 6th he crossed the Main Stem at Bardstown Junction, on his way north, burning Long Lick water station, and damaging the adjacent bridge. He has not returned since (October 1st, 1863) being now confined a prisoner of war in Columbus, Ohio. Table XXII shows the damage done to the road, from July 1st to October 1st, 1863."

to one common measure per mile of road and per train mile. His annual reports became bulky pamphlets, consisting largely of tabular statements, from which sound deductions could be drawn. They were in the nature of a revelation to other railroad managers and experts. In these reports, Mr. Fink not only gave in detail the results of the operations during the preceding year, and showed how further economies might be attained, but he also discussed those larger politics of railroad management relating to tariffs, alliances, and extensions, which, when carried out by him, subsequently made the Louisville and Nashville the great system which it has become, in spite of the fact that its geographical position scarcely seemed to warrant that result in the beginning. Under his advice the road was extended to Montgomery, Ala., by acquiring the charter of the South and North Alabama Railroad Company, and upon its completion in October, 1872, he became Vice-President of that company, having held a like position on the Louisville and Nashville since July, 1870.

In reading Mr. Fink's annual reports one is impressed with his absolute candor. He never warps the facts or the argument, and he tells all there is to be told. He points out what increased earnings are due to temporary causes, such, for instance, as the increased southern traffic just after the war, before the other lines in the South could be placed in condition to compete. He shows so convincingly the unreasonableness of the chronic complaint of some local shippers that their rates were out of proportion to the through tariff, as to have put an end to that class of fault-finding for a time. He is the first to show conclusively by statistics that a branch line, unprofitable in itself, may yield an adequate profit when the increased traffic of the main line owning its securities is taken into account, and he discusses in a masterly way some of the general features of the railroad problem, such as through and local rates, effect of water competition, etc., etc.

All this was done amid the engrossing cares of reorganizing, managing and rebuilding a railroad in a region where the lawless element was still active, for in 1866 and 1867 various outrages were committed, such as the wrecking and robbery of the pay car, the wrecking and plundering of a passenger train, the robbing of a depot agent, etc. Mr. Fink prosecuted the perpetrators with great vigor. Most of the robbers were discovered and arrested. Two of them who had killed a comrade for divulging were executed, and a number of the others were sent to the penitentiary.

Mr. Fink's reports attracted such general interest among railroad men that copious extracts from the report of 1873–74 were reprinted for general circulation under the title of "Cost of Railroad Transportation." This was followed in 1874 by a treatise entitled "Investigation into the Cost of Passenger Traffic," based upon the traffic of the Louisville and Nashville Railroad since 1867, which was to have been

followed up by a second part containing the results of an investigation into the cost of freight traffic, the completion of which was prevented by Mr. Fink's official duties. The portion thus published discussed with conciseness the causes which affect the cost of transportation, the expenses connected with passenger trains, the character of the loads carried by them, with the cost of each class, the effect of an increase of business upon the cost, and the cost of mail and postal service. So able was it all that another edition was called for in 1876, and Mr. Fink was invited to appear before the special commission of Congress on "Railway Mail Transportation." The pamphlet, which was reviewed at length in the *Railroad Gazette* of May 30th, 1874, remains a classic to this day, and the full and convincing work of this distinguished engineer is still almost the only known treatise upon the abstruse subject of the cost of railroad transportation.

These continuous and absorbing labors doubtless induced in Mr. Fink a certain sense of fatigue; moreover, he desired to complete his studies of the cost of freight traffic, which traffic he believed to be more important and complicated than that done on passenger trains, and he, therefore, declined a re-election as Vice-President and General Superintendent at the annual meeting of the stockholders of the Louisville and Nashville Railroad in October, 1875. Very complimentary resolutions (published in the annual report) were passed by the directors of the road, and he began preparations for a long European trip. He was not suffered thus to get out of harness, however, for the "Southern Railway and Steamship Association," already in existence, was then looking about for a commissioner, and persuaded him to take the place until matters could be put into smooth working order.

In 1875, Mr. Fink entered on the work for which, consciously and unconsciously, he had been preparing for years. It was a work of great originality, and of difficulties quite as great. A critical period in the history of the railroads of the United States had been reached, and, in the decade between 1870 and 1880, a very important change took place in the attitude of those who controlled railroad properties toward the owners of those properties, toward other railroads, toward society and toward the State. In bringing about this change Mr. Fink had more to do than any other man, perhaps more than any other dozen men.

Very briefly stated, the change was something like this: The stage of expansion began to give way to the stage of organization. The unscrupulous, the "smart," and the corrupt railroad officers began to sink in relative numbers and power, and the men of high professional spirit became relatively more numerous and more influential. The theory that railroads were merely private properties, worked only for the profit of owners, or often for the personal gain of officers, began to give way to the theory that railroads are quasi-public institutions

enjoying valuable powers and privileges received from the State, and having corresponding duties and obligations to the State. The theory of the control of rates and service by competition broke down and began to give place to the theory of control by combination. It must not be supposed that these changes came about all at once, or that they are yet complete, or that they have gone on during the last twenty-five years without interruption; but the tendencies to these changes began to be strongly marked at this period in Mr. Fink's career.

The Southern Railway and Steamship Association was organized in 1875. It was a combination of about twenty-five southern railroads, formed for the purpose of controlling and regulating rates, to the end that they might be kept reasonally permanent and so controlled as to lead to the least possible discrimination between persons or places. It requires slight familiarity with the social economics of railroads to appreciate that such regulation of rates would sweep away most of the evils felt by the railroads themselves and by the communities which they served. The Southern Railway and Steamship Association was the first really important and influential combination of this kind, and one of the most successful ever established. It was largely of Mr. Fink's creation and was a highly organized institution. It was designed as a machine to enable the railroads to work together with or without pooling, as might be thought expedient. But the association was much more than a pool. While it was designed to divide the competitive traffic, it was designed further to facilitate handling the through traffic. To that end it arranged classifications and rates, and it served as a clearing house for through-traffic accounts. Of this great organization Mr. Fink was the working chief, and all who are able to judge agree that its affairs were well managed from the start. The plan of work and the body of rules were prepared by Mr. Fink with German painstaking and thoroughness and were administered by him with distinguished ability, justice, tact and resolution.

In May, 1876, Mr. Fink felt that he could withdraw to resume his plan of rest and study, and after about a year spent in Louisville to arrange his personal affairs, he started in June, 1877, for a trip to Europe. This time he got as far as New York, arriving there at a time when the chief executive officers of the four eastern trunk lines were endeavoring to compass measures to prevent the recurrence of the disastrous railroad war of the preceding year. Mr. Fink was consulted, and so greatly impressed the executive officers that they prevailed upon him to organize and to conduct the affairs of their proposed association, upon a plan chiefly devised by himself. The Trunk Line Association which was then formed included the Baltimore and Ohio, the Pennsylvania Railroad, the Erie and the New York Central and Hudson River Railroad. It was established to divide the west-bound traffic. Late in 1878 these lines and their western connections, north of the

Ohio River, and east of the Mississippi River and to the Atlantic, and including also the Louisville and Nashville, agreed to co-operate in all matters relating to competitive traffic, and the Joint Executive Committee was formed. Of this Mr. Fink was made Chairman, retaining also his commissionership of the Trunk Line Association. He thus became the executive officer of all the most powerful railroads in the United States, so far as concerned their competitive traffic arrangements. That he occupied a position of great power and great delicacy no one will deny. That he filled it with remarkable skill everyone will admit. Mr. Charles Francis Adams said:

"It is safe to say that the greatest of all these combinations, that of the Trunk Lines, is held together only by the personal influence and the force of character of one man, its Commissioner, Colonel Fink."

With numerous troubles and vicissitudes the Trunk Line Association was held together, and in 1898 it is still in existence, but its power and capacity were much abridged by the Federal Inter-State Commerce Act which went into effect in 1887. Mr. Fink resigned in the middle of 1889, partly for the reason that Federal legislation nullified to some extent the effect of his labors and partly for the reason that his health was failing. Indeed, for two or three years before his resignation he had been absent from his office a great deal.

The Joint Executive Committee gave place to the Joint Traffic Association which was so organized, it was believed, as to conform to the Inter-State Commerce Law and to aid, rather than to retard, the operations of that law. The Southern Railway and Steamship Association also underwent vital reorganization after the passage of the act. Many other associations of much the same character as these have been formed and still live, but on all of them Mr. Fink's influence is felt as a lasting force.

During Mr. Fink's long-continued and far-reaching labors in this great field he was associated with and aided by many able men, students or administrators, or both, but among them all he stood pre-eminent. In the establishment and growth of correct ideas of rate-making and classification he was an original student, investigator and teacher. In the development of methods of organized co-operation among railroads he was a leader. In discovering and formulating the true theories of the relations of railroads to each other and to their patrons and to the State he was one of the earliest of the really scientific philosophers.

Mr. Fink's mind was broad and comprehensive, but it was also stored with detailed information. He had a solid and clear knowledge of his subject acquired in his own way, at first hand, and thus he commanded his knowledge. His analyses of the cost of transportation, begun on the Louisville and Nashville, were the most complete that had appeared up to that time, perhaps the most complete ever made, and they have served as a basis for much of the work of other students

along these lines. Professor Hadley says that Mr. Fink's Report on Transportation Rates to the Seaboard

"Is one of the most successful applications ever made of mathematical methods to social phenomena. It ought to give Mr. Fink as high a rank among scientific investigators as he holds among practical men."

In Mr. Fink's dealings with the problems of railroad management and of their relations to each other and to the people of the nation, he did not permit himself to be guided by theories which he had evolved. He knew no such easy process. He was a true Baconian. He learned the facts as far as in him lay (and his powers of acquisition were great), and his theories grew from such knowledge, but under it all lay the clear, just spirit which could detect the real and the false and which was always directed toward an ideal justice. In one of the United States Senate inquiries by special committee, Senator Harris asked Mr. Fink if he would be willing to formulate, in the shape of a bill, such legislation as he would recommend. Senator Harris said: "I make this suggestion to Mr. Fink because I know of no man in the whole country who has more extensive and accurate information upon the railroad side of this question." Mr. Fink promptly added: "And upon the other side, too; I am looking upon the other side as well as upon the railroad side."

Mr. Fink was as far as possible from socialism. He believed in the free play of the forces that emperors or legislators cannot control, the forces which really make human progress. He always contended for the common law which embodies the wisdom and experience of past ages and which cannot be improved by special legislation; and Mr. Fink's labors if fully accepted would have made most special railroad legislation unnecessary, or would have so directed it that it would have been more efficient and beneficial. Thus he was a man whom Germany could ill spare, and whose teachings and example have helped to make our own nation strong and free.

At the first meeting of the officers of roads in the Joint Traffic Association, held after Mr. Fink's death, Mr. George R. Blanchard, Commissioner of the Association, and who, as an officer of the Erie Railway, had taken a prominent part in the establishment of the Trunk Line Association, of which Mr. Fink became the head, presented the following minute, which was unanimously adopted and ordered to be recorded, both by the managers and by the Board of Control.*

"Albert Fink, born at Lauterbach, Germany, October 27th, 1827, and who died April 3d, 1897, was from June, 1877, to July, 1889, the Commissioner of the Trunk Line Association, the Chairman of the Joint Committee, the Secretary of the Presidents, and in many instances their arbitrator. Being chosen because of his prior demonstrated fitness for those duties, he brought to their performance a thorough education and a rare combination of organizing, executive

* *Railroad Gazette*, April 16th, 1897.

and judicial faculties and ability; exercised his complex duties with eminent fairness, and with just consideration for mutual rights, and left the association voluntarily, bearing the esteem and regrets of all his associates and competitors.

"In the conduct of his duties he showed rare powers of concentration, analysis and statement, a comprehensive mind, alive to the development of the railway system and the public business and their mutual relations, the intricacy of the problems which he confronted, a thorough devotion to the task of solving the great difficulties encountered, and exceptional courage and discretion. His decisions were rarely appealed from, and most often to himself. Even when he was most characterized by the public as an autocrat in transportation rates and rules, he was giving the wisest and most liberal consideration to their interests. If the great duty which he had undertaken—to harmonize the extended rival interests which he served—was not accomplished, it was through no fault of his devotion or administration; and the expressions of his own regrets, when he left his duties, that he had not entirely achieved his purposes, will be remembered by all as a tribute to his sincerity, and should afford an incentive to continued effort to the same great ends on the part of those who now administer the same properties."

When, after this strenuous business life, the imperative need of rest came to him, Mr. Fink resigned the office of Trunk Line Commissioner, in 1889, and went for a few months to Europe; thence returning with his only child, a daughter, to Louisville, Ky., he reopened the old home where he had spent the short period of his happy married life with Sarah Hunt. He kept it as a *reste à pied*, traveling extensively, both in this country and in Europe. Scenery was a source of great enjoyment to him, and he was interested in everything great and small, from the social problems of the places he visited to their local coloring and customs. While at home he occupied himself with his books, spending the better part of every day and far into the night reading with intense interest works on philosophy and history. In his retirement he missed greatly his active business life, but, although he had many tempting offers to return to it, he declined them all.

During the last two years of his life he had severe attacks of illness caused by kidney trouble, each one sapping more his strength, both physical and mental, until his death, which came suddenly and without pain early in April, 1897.

Albert Fink's chief characteristics were conscientiousness, passionate love of truth, fine sense of justice, perseverance, untiring energy, dauntless courage and strong will. Nothing could make him deviate from his path of duty. His strong analytical mind never rested until it had found the truth, the bed-rock of facts, and had discovered all the reasons why things were so and could not be otherwise. His decisions on questions submitted to him for arbitration were nearly always correct, and were readily accepted by both sides. His tenacity of purpose, his uncommon intellectual powers, and the power of concentration, which he possessed to a remarkable degree,

enabled him to solve intricate problems in fields of labor for which he had not prepared himself, and in which he had but little experience. As an energetic worker he had, perhaps, no equal among his contemporaries. Courageously and unswervingly he advanced to the goal he had set for himself in his early youth; to educate himself thoroughly, to develop his faculties to the widest extent and so rank with the highest in his profession. When he undertook work or study he gave all his energy to it, and he did it thoroughly. He was deeply versed in philosophy and history, and interested in science, literature and art, and in touch with all the questions of the day.

His fairness, honesty and integrity made him admired by the men with whom he came in business contact. In his business dealings, he was not only straight from a business point of view, but he was morally straight. Several of his inventions made the fortunes of other men, he himself neglecting to exploit these fruitful sources of wealth. The utility and perfection of his work were his goal, not the amassing of a fortune. His employees were devoted to him; they cheerfully performed the duties he assigned them and took the deepest interest in his success. Even now, after so many years have passed away, they refer with pleasure to the fact that they once worked under him.

Albert Fink was distinguished in appearance and unusually handsome. He was tall and well proportioned. He had a noble head and broad forehead. His mouth and chin showed the strength and force of his character, while the expression of his large, dark eyes was wise, calm and thoughtful and infinitely tender. When he spoke, what he said was clear, concise and to the point; in a very few words he told a great deal.

He enjoyed society, but his life was too busy for him often to be able to indulge in social pleasure. His manners were simple and very cordial. The strength and simplicity of his character and the kindness and gentleness of his nature won for him the affection of men and women, young and old. He had a strong and tender love for little children. In his tastes he was simple, and he spent little for his personal uses, but he was lavish in giving. No one ever called upon him in vain for assistance, and, without being called upon, he lightened the burdens of many who will remember him with grateful hearts. To be able to do good, to relieve suffering, was his principal happiness. He was a most remarkable man, a true gentleman, and one who had reached the highest type of humanity.

Mr. Fink was elected a member of the American Society of Civil Engineers on July 20th, 1870; he became a Fellow on September 3d 1872. He served as Vice-President of the Society from November 7th, 1877, to November 5th, 1879, and as President from November 5th, 1879, to November 3d, 1880.

SAMUEL KILLEBREW, M. Am. Soc. C. E.*

DIED JANUARY 9TH, 1899.

Samuel Killebrew, son of George W. and Mary A. Killebrew, was born near Oak Grove, Christian County, Ky., May 14th, 1840. From early childhood he manifested a taste for mathematics, which his parents encouraged and cultivated, placing him under the care of the best teachers in the vicinity of their home and giving him a thorough preparation for college. He entered college at Russellville, Ky., in January, 1856, and remained two years, leaving, to assume his first work in the line of his chosen profession.

He began his career in engineering as rodman under Col. George B. Fleece, Chief Engineer of the old Memphis, Clarksville and Louisville Railroad in 1859. Mr. John B. Tapscott, who was in charge of the division on which he was employed, says of him:

"He was a country boy of rough exterior and looked as if he could manage a plow team or split a rail better than he could manipulate a transit or level. In less than two weeks I found my country boy was far from being a bumpkin, but was a close, observing, accurate and valuable assistant."

He continued in the work until the Civil War began, when he left the railroad to serve the Confederate Government. In 1870 to 1878 he was employed in various capacities in the location and construction of the Brownsville and Ohio Railroad in Tennessee, his continued advancement from rodman on preliminary survey to responsible charge of construction bearing evidence of his energy and ability.

In 1881 he was appointed Assistant Engineer of the Galveston, Harrisburg and San Antonio Railway, then being built from San Antonio, Texas, westward to a connection with the Southern Pacific, and was assigned to duty as instrument man in a locating party. It was on this work that the writer first met him, and here began a friendship which only terminated with his death. As is often the case when a new man joins a party that has been in the field for some time, Mr. Killebrew was not welcomed with much cordiality by some of the members of the party. On one occasion, the engineer in charge being on reconnoissance and Mr. Killebrew being in charge, there was an open revolt against his orders. The manner in which he handled this trouble showed a firmness that would not permit trifling, but withal a kindly spirit of forgiveness that won for him the good will and respect of all the party. Not long after this "the Major" was the most popular man in the party and he was never troubled again.

At this time it was found very difficult to get a location over a certain summit, with the adopted gradient, and while the party was

* Memoir prepared by E. B. Cushing, M. Am. Soc. C. E.

on this work, Major Killebrew was detached from the regular corps to assist in reconnoissance. With a corps of only two men, and with only a surveyor's compass and chain he worked out a line that was located and built upon. This was the opportunity that demonstrated his ability, and Major Converse, the Chief Engineer, gave him charge of a party on another location. During the year that followed he located a line to Fredericksburg, Texas, 70 miles, and from La Grange to Bastrop, Texas, 35 miles. Though the company for which these lines were located did not build them, yet other corporations have since constructed the roads. Notwithstanding they had the best engineering talent, their constructed line does not vary appreciably from Mr. Killebrew's stakes.

In 1882, when Mr. C. P. Huntington and his associates decided to build into Mexico, Major Converse was asked to recommend a man to locate the line. He sent Mr. Killebrew to New York, and Mr. Huntington, with his good judgment of human nature, at once employed him. This may be called Mr. Killebrew's life work and his monument. Beginning at Piedras Negras, Mexico, in the middle of a hot summer to locate a line through a foreign country, the inhabitants of which were not generally friendly to "Gringo" intrusion, the language, customs and laws being entirely new, and the water, food and forage supplies being meager, he was beset from the first with difficulties that were extremely trying. With no precedents to guide him and with imperfect and unsatisfactory maps to indicate his course, he started his work with the same confidence and cheerfulness he had displayed in former undertakings. Mounting his mustang pony, his little compass and hand level in his saddle bags, he bade us farewell and started for the mountains. When, in ten days, he returned, the general line of the Mexican International Railroad, over the first mountain pass, as it is to-day operated, was determined.

This line, as constructed, has several mountain summits to overcome and stream crossings to make, the detailed location of which involved some prompt decisions on general points, as well as nice adjustments as to details. In addition to this, the location was made through a country where adequate food and water supply was wanting. There were frequent depredations by roving bands of Indians or by natives disguised as Indians, who were worse than the originals. The question of properly maintaining a party was often as trying as the work itself. During all this time Mr. Killebrew never once lost his control of the situation, but anticipated and provided for probable emergencies, spending much of his own time long distances ahead, looking out the way, and between the preliminary corps and the locating party, which were generally 25 to 40 miles apart. His presence around the camp fire encouraged the men, and his wonderful grasp and memory of topography rendered easy the work of his

assistant engineers. He never permitted a party to leave a district between two controlling points until both the assistant engineer in charge and himself were satisfied that the line in detail was where it should be and no considerable improvement was possible.

On one occasion, the owners of the property and their consulting engineer were anxious to build the road as close as possible to a certain town. Mr. Killebrew abandoned all work ahead and ordered both his corps to the work of modifying the line, assigning one party to each side of the river and directing both in person. When the final determination was made, it was after every available route had been tried. The line, however, was not satisfactory, and as the construction advanced, other engineers were detailed to get one nearer in. Major Killebrew heard of this, but instead of being hurt, he said: "I hope they will get what is wanted, but I am afraid they will not." The road was built on the Killebrew line.

He remained with this company until all its projects had been explored and much of the line built. In 1889 he was employed by the Mexican Pacific Railway in a very difficult location on the Atlantic side of the mountains, in Southern Mexico. This location led to the head of navigation on the Grijalva River, at San Juan Bautista. A portion extended through a mountain range entirely unknown, and as the coast was approached, the route lay through swamps and a dense tropical jungle, in which life was made a burden by the swarms of stinging insects and the dangers of bites from venomous reptiles. His principal assistant, Arthur C. Wheatley, Assoc. M. Am. Soc. C. E., writing of this work, says: "He was always cheerful and encouraging in spite of the dangers, difficulties and sickness which surrounded us." On the completion of this work he returned to his home in Brownsville, Tenn.

When the Mexican International decided on further extensions, Mr. Killebrew was again sent for and placed in charge of the surveys. He made some extensive reconnoissances and surveys, including lines from Durango to Guadalajara, Durango to Guanacevi, Durango to Mazatlan, and many others; his work for this company embracing, probably, between 2 500 and 3 000 kilometers of final location, much of which was built. He was engaged in surveying a line from Durango to the Pacific Ocean when the final sickness came on him, and he died in Durango, Mexico, January 9th, 1899.

A chronological statement of his work does not constitute a proper memoir of Samuel Killebrew, for he was an extraordinary man in many respects. He was very simple in his tastes and very approachable. He was genial in manner and would go out of his way to show attention to the people living along the line of his surveys. His judgment of topography was a natural gift, but one that he always cultivated. He could ride through a new country and estimate with a wonderful

degree of accuracy the differences in level and distance between the controlling points. In later years, his health was broken, but his energy prior to this was ceaseless. He never let anything divert him from his work, and he instilled in those around him such interest in the work in hand that it was a topic of general conversation around the camp fire at night. In this way, the work was made as pleasant as possible to those who had to bear the burdens. He was painstaking with his men, never losing interest in showing them how to solve the problems that came up daily on such work, and many an engineer will, with the writer, always feel grateful for his kindly interest and assistance in those days of early trials and hardships. He was liberal with his men, and even in early days, when working on a small salary, he would share his earnings with those in need as cheerfully as when later on he could better afford to do so.

He was loyal and faithful to the interests of his employers, and had the work been his own, he could not have given it more attention. As a man, he never outgrew his boyhood's reverence and affection for his parents, and often on trips he would speak with the greatest affection of his mother and tell anecdotes of his early training. His wife accompanied him on the survey whenever it was practicable for her to do so, and was with him when he died.

His work is a monument to his professional skill, and he has left in the hearts of those who were with him tender memories of his many acts of kindness which they will never forget.

Mr. Killebrew was elected a Member of the American Society of Civil Engineers, September 2d, 1885.

FREDERICK HENRY SMITH, M. Am. Soc. C. E.*

DIED DECEMBER 24TH, 1898.

Frederick Henry Smith was born in Pittsburg, Pa., on November 10th, 1839, and there his early schooling was effected. At the age of thirteen he went with his uncle, Col. James Shaler, to Lake Superior, where, as a boy, in immediate contact with some of the great mining industries, he acquired his taste for geology and mineralogy. When but sixteen years of age he entered the engineering service of the Louisville and Nashville Railroad, under the late George MacLeod, C. E., and continued in this field until the breaking out of the Civil War, when he became a military engineer in the service of the Confederate States.

Here, besides serving on strictly military duty, he was detailed to the Niter and Mining Bureau, where he devoted his energy to the production of saltpeter and other material required for munitions of war. The caves of Alabama, Georgia and Tennessee were ransacked, under his guidance, for niter to supply the powder-mills. He was also engaged during the war in rehabilitating some of the old and disused iron-smelting furnaces, and in other metallurgical work.

At the close of the war, Captain Smith turned his varied experience to the practice of civil engineering, and, establishing himself at Baltimore, Md., became a member of The Baltimore Bridge Company. This connection was terminated in 1873, Captain Smith continuing his practice at Baltimore, and devoting much of his time to the design and erection of bridges. He became Engineer of Bridges to the City of Baltimore, and Consulting Engineer for the railroads of the Seaboard Air Line. In both these capacities he executed some excellent examples, among others the handsome stone arched North Avenue Viaduct, in the City of Baltimore, which is likely long to remain as a monument to his professional ability.

His interest in geology and mineralogy led him to employ such brief intervals of leisure as came to him in the preparation of a popular hand-book, entitled "Pocket Geologist and Book of Minerals," which he published in 1877. This was revised and republished in 1882 as "Rocks, Minerals and Stocks." In 1890, he published the "Pocket Geologist and Mineralogist," and in 1895, "Smith's Hand-Book of Valuable Minerals: What They Are; What They Look Like; Where To Look for Them," a duodecimo of 238 pages. These small volumes are full of useful and practical information for the prospector and miner, and contain in pocket form much valuable matter in relation to rocks and minerals.

* Memoir prepared by Mendes Cohen and C. H. Latrobe, Members, Am. Soc. C. E.

During the last year of his life, he was the engineer member of the State Board of Health of Maryland, where his general knowledge and experience made him an efficient member, whose opinions were highly valued by his colleagues.

Mr. Smith's health broke down completely several years before his death, but notwithstanding constant suffering, his fortitude, energy and patient good humor, sustained him to the last. He became a Member of the American Society of Civil Engineers on February 21st, 1872, and although he never took a very active part in the deliberations of the Society, yet he was always esteemed a valued member. He married on December 27th, 1870, Miss Elizabeth Gairdner, of Augusta, Ga., who, with two sons and one daughter, survives him. He passed away quietly and peacefully, much regretted by those who knew him best.

WILLIAM GARNETT WILLIAMSON, M. Am. Soc. C. E.*

DIED AUGUST 2D, 1898.

William Garnett Williamson, eldest son of General Thomas H. and Louisa Garnett Williamson, was born in Norfolk, Va., December 13th, 1840. He attended Fuller's Classical School, of Lexington, Va., and then entered Washington College (now Washington and Lee University), Lexington, Va., from which he was graduated in 1859, with the degree of B. A. He was afterward privately instructed in Civil Engineering by his father, who, for nearly fifty years, was Professor of Engineering at the Virginia Military Institute. His first service as an engineer was with General Robert E. Rodes upon railroads in Alabama. At the breaking out of the Civil War he volunteered in the Confederate Army as a private in the college company, but was soon transferred to the Rockbridge Artillery, and served with that battery under Captain, afterward General, W. N. Pendleton until he was appointed a Lieutenant of Engineers and assigned to the command of General Stonewall Jackson. Captain Pendleton was the Rector of Grace Church, Lexington, and some of Mr. Williamson's earlier military service was thus with his friend, his pastor and the instructor of his boyhood. As First Lieutenant of Engineers, Mr. Williamson was assigned to the First Regiment of Engineer Troops, C. S. A. (commanded by Colonel T. M. R. Talcott), of the Army of Northern Virginia. He was subsequently promoted to the Captaincy of Company F of that regiment, and served with it until the surrender at Appomattox Court House, where he was paroled.

After the war Mr. Williamson went to Mexico and there engaged in the construction of the railroad between Vera Cruz and the City of Mexico, of which Colonel Andrew Talcott, father of his regimental commander, was the Chief Engineer. Returning to Virginia in 1867 he was for six years engaged in railroad work in Virginia, North Carolina and Kentucky. From 1871 to 1873 he was in charge of the construction of shops, depots and yards, for the Chesapeake and Ohio Railroad, at Huntington, W. Va., and was Division Engineer of the road. From 1874 to 1876 he was Assistant Engineer on the Tennessee River surveys. Returning to railroad work, a year was passed in the service of the Buchanan and Clifton Forge Railroad in Virginia, as Division Engineer, and in 1878 he was again in the Government service as Assistant Engineer on survey work in Currituck Sound, N. C., the Nattoway, Chowan and Tar Rivers. In 1879–1880, he was with the Richmond and Danville (now the Southern) Railroad as Engineer of Bridges, under Colonel Henry T. Douglas, M. Am. Soc. C. E., with whom he was associated for several years. From 1880 to 1882 he was Assistant Engineer with the late General Quincy A. Gillmore, M. Am.

* Memoir prepared by the Secretary from information furnished by W. E. Cutshaw, William Cain and Geo. G. Earl, Members, Am. Soc. C. E., and from papers on file.

Soc. C. E., in the United States Survey of the Altamaha and Canoochee Rivers in Georgia, and later was Assistant Engineer on the survey of the Cahaba Coal Field, in Alabama.

He next undertook the construction of a sewerage system for Montgomery, Ala., from the plans of Rudolph Hering, M. Am. Soc. C. E. After the completion of these sewers, in 1883, he was elected City Engineer of Montgomery, and inaugurated a plan of improvements for that city. The work of a city engineer did not suit his sensitive nature, and in 1888 he resigned this position and again entered the government service as United States Civil Assistant Engineer on the Alabama River under Captain Hoxie, where he remained about one year. In 1888 he opened an office in Montgomery, Ala., for general engineering work, in which venture George G. Earl, M. Am. Soc. C. E., was associated with him. The firm continued for only about two years, during which time sewer design and construction and water-works extension for Americus, Ga., and sewerage plans for Columbus, Ga., were undertaken. Mr. Williamson had other work in hand at the same time, including sewerage plans for Sheffield, Ala., and the improvement of the grounds of the Alabama State Capitol. Government work and surveys, where he could be surrounded by friends, were always attractive to Mr. Williamson, and hence, in 1891, he went with the United States Engineers on river and harbor work again. He was engaged under Major F. A. Mahan as United States Civil Assistant Engineer on the Coosa River, where he remained until the war with Spain began, when he was transferred to Pensacola, Fla., and had charge of work upon fortifications and harbor defences. While upon this work the climate and overwork brought on an attack of dysentery which resulted in his death.

Mr. Williamson was descended from English ancestors through a line of distinguished Virginians. He was an engineer of more than usual ability, both in theory and in practice, a better mathematician than most engineers of ante-bellum college training, precise in everything and an excellent draftsman. He was devoted to his profession and untiring in his duties, a man of varied experience, and, in the words of one who was associated with him, "so honorable in every relation of life, particularly professionally, that there would be no need of a code of ethics in the profession, were all its members but one-half so far above temptation as was Captain Williamson." Another engineer writes of him as "one of the most open-hearted and lovable of men, honest and true to a fault, and, withal, a man of uncompromising principle." He married Miss Bettie Cralle, of Huntington, W. Va., October 10th, 1873, and she and seven children survive him.

Mr. Williamson was elected a Member of the American Society of Civil Engineers April 4th, 1883.

WILLIAM ROBERTS MICHIE, Assoc. M. Am. Soc. C. E.*

DIED FEBRUARY 2D, 1899.

This young engineer, cut off in his prime, was born at Yanktown, McDowell County, N. C., September 22d, 1866. His father, Peter S. Michie, now Professor of Natural and Experimental Philosophy at the United States Military Academy at West Point, had served with distinction through the Civil War, had risen to the rank of General of Volunteers, and was at that time in the regular army. As the engineer officer of the Army of the James, Gen. Michie had rendered distinguished services, so that the son came by his taste for engineering in a manner almost hereditary. It was the desire of the parents that the young man should be educated at the United States Military Academy, but, owing to a slight trouble with his eyes, he was sent instead to Dartmouth College, where he was graduated as a civil engineer, in April, 1889, from the Thayer School of Civil Engineering. Professor Robert Fletcher, the head of the Thayer school at that time, was a graduate of West Point, so that, although Mr. Michie was denied admission to the Military Academy on account of a disability which was never perceptible, he nevertheless obtained an education modeled very much on the West Point lines. He showed his ability at once on graduation to such an extent that after a brief service on the St. Louis and San Francisco Railway he rose to the position of assistant engineer. He had charge, for that railway, of the construction of a pier and one span of the Red River Bridge, and made surveys for wing dams to change the current of the Red River.

He entered the service of the Pennsylvania Railroad Company, April 20th, 1889, upon the recommendation of Mr. Frank Thomson, and had occupied the following positions on this celebrated railroad: 1889, chainman on construction of the Ardara Bridge, also at Viaduct and South Fork Bridges until August, when he became rodman on the construction of the Wall repair shops; 1890, in July, Acting Assistant Engineer in the construction of a new yard at Altoona; in October promoted to Assistant Engineer, Altoona yards, surveys for South Fork Railroad and part of its construction; construction of Wall yard and round houses, a large railroad yard near Pittsburg; construction of the Sang Hollow extension, approximately fifteen miles; 1895, construction of third and fourth-track work on the Pittsburg Division and at various points on the Johnstown Branch; 1896, completing the Wilmerding Branch, and on the new line at Nineveh and the Radebaugh Tunnel; 1897, construction work on the Pittsburg Division, change of line and additional tracks at various points; 1898, construction work, additional track-work in Johnstown and vicinity and the Portage Tunnel; 1899, resigned January 10th.

* Memoir prepared by William H. Wiley, M. Am. Soc. C. E.

To show what rare capacity he exhibited at the beginning of his career some details are given: In November, 1890, within six weeks' time, he made the surveys for the extension from South Fork to Dunlo, and the line was afterward built on his location. The change of line from Portage to Tilly was also constructed practically in accordance with Mr. Michie's surveys, made in 1891. In that year, also, Mr. Michie had charge of much important work on the Pittsburg Division. Entering upon the construction of the extensive Wall yards, in the early stages of the work, he carried it to completion in December, 1892, and built at the same time a 44-stall roundhouse. Under his direction the line between Turtle Creek and Brinton was changed, and the Wilmerding Branch Railroad was constructed.

After the Johnstown flood Mr. Michie was engaged in the reconstruction of the track, and was inspector in charge of the construction of the celebrated Viaduct Bridge near South Fork, Pa. This structure, which is notable as one of the largest arch bridges in the United States, has two 80-ft. spans and is over 100 ft. in height. He also had charge of the extensions to the large arch bridges over the Juniata River; five spans of 60 ft. each. In addition to the record of service given as above by years, Mr. Michie was in charge of numerous important surveys for changes of the line and branches on the Philadelphia and Erie, and on the Northern Central Railroads, as well as on the Baltimore and Potomac Railroad, near Washington, D. C. He had full charge of building the Radebaugh Tunnel, 2 100 ft. long, near Greensburg, Pa., and was so successful with this work that he was detailed to superintend the rebuilding of the celebrated Portage Tunnel at Gallitzin, Pa. This was the last construction work he undertook for the railroad company, as he resigned his position in January, 1899, to accept an advantageous appointment in Cuba. Mr. Michie was quite familiar with the uses of steam and with steam engines and machinery generally, and could handle a locomotive, apparently, as well as the engine-runner.

This, in brief form, is the record of an engineer who, had he lived, would have attained great distinction in his profession. The writer knew him when he was a boy, and he possessed such lovable traits of character that he drew everyone toward him. As a man he justified all these early characteristics and was one of the most popular men on the Pennsylvania Railroad. For the preparation of this memoir there were available not only many personal letters from his associates and from those under his immediate charge, but also newspaper extracts containing accounts of Mr. Michie and his work, and all of these expressed the sentiment of a personal loss sustained by the writers.

Mr. Michie was elected a Junior of the American Society of Civil Engineers, February 28th, 1893, and an Associate Member, October 7th, 1896.

WATERMAN STONE, Assoc. Am. Soc. C. E.*

DIED MARCH 30TH, 1896.

Waterman Stone was the eldest son of Lemuel M. E. Stone, one of the engineers engaged in early railroad work in New England, and was born in Cumberland, R. I., March 10th, 1847. His engineering training was under his father's direction. In 1871 he succeeded his father as Superintendent and Engineer of the Providence, Warren and Bristol Railroad, and during the eighteen years he held this position he designed and supervised all the improvements made on the road. The most notable of these was the construction of a curve of 211 ft. radius in the main line, just outside the City of Providence, R. I., to enable trains to enter and leave the city head on. A bluff 130 ft. high rose from the East Providence shore of the Blackstone River at the point where the railroad crossed, and since the construction of the road, trains had been run on a Y-track above the bridge, and were pushed in and out of the city. Mr. Stone put in a 27° 20′-curve between the river's edge and the bluff. A modified Fairlie type of locomotive was built to haul trains around this curve and standard eight-wheel American type locomotives were also run over it. The forward pair of driving-wheels of such engines was equipped with blank tires with a width of tread of 7 ins., and third and fourth rails were laid on the curve for the blank tires.

On the absorption of the Providence, Warren and Bristol Railroad by the Old Colony system, Mr. Stone removed to Kansas City, Mo., where he became Superintendent of the Inter-State Rapid Transit Railroad. This was a cable railway, but during the four years of his service electric traction was installed. Returning to the East, Mr. Stone began practice as a consulting engineer, with especial reference to electric railroads. He had built several roads and was engaged upon others at the time of his death.

Mr. Stone was a man of sterling character, and his kindly disposition and love of fair play made him as popular with his employees as with his more general acquaintance. Of mathematical tendency, he was an earnest student in fields not bounded by his professional practice. He was elected an Associate of the American Society of Civil Engineers, December 1st, 1886. While in the West he was Secretary and Treasurer of the Engineers' Club of Kansas City, and he was the first Secretary of the American Society of Railroad Superintendents.

* Memoir prepared by the Secretary from information furnished through E. P. Dawley, M. Am. Soc. C. E., and from papers on file.